

**IMPACT OF INTELLECTUAL PROPERTY PROTECTION ON BUSINESS
INNOVATION IN SICHUAN PROVINCE**

XUAN DING

**A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF
PHILOSOPHY PROGRAM IN BUSINESS ADMINISTRATION
FACULTY OF BUSINESS ADMINISTRATION
RAJAMANGALA UNIVERSITY OF TECHNOLOGY THANYABURI
ACADEMIC YEAR 2024
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Dissertation Title	Impact of Intellectual Property Protection on Business Innovation in Sichuan Province
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Program	Business Administration (Management)
Dissertation Advisor	Assistant Professor Sirinya Wiroonrath, Ph.D.
Academic Year	2024

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ABSTRACT

This dissertation has three main objectives. First, it aims to elucidate the relationship between intellectual property protection and firm innovation in Sichuan province. Second, it investigates the impact of intellectual property protection on firm innovation outputs through technological innovation. Lastly, it explores the influence of intellectual property protection on firm innovation outputs through firms' R&D capabilities.

The study employed a mixed-methods approach, integrating both quantitative and qualitative analyses. In the quantitative phase, data were collected from questionnaires completed by 502 representatives of state-controlled and private firms in Sichuan province, China. The survey data was analyzed using SmartPLS and SPSS software to identify both direct and indirect impacts, as well as mediation effects. For the qualitative analysis, interviews were conducted with managers from both state-controlled and private firms in Sichuan Province, followed by content analysis.

In conclusion, it is recommended that the national intellectual property policy framework be strengthened to foster a thriving innovation ecosystem, providing a strong theoretical basis for policy reform.

Keywords: intellectual property protection, firm innovation, Sichuan Province

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List of Abbreviations

IPP	Intellectual Property Protection
FIO	Firm Innovation Outputs
LEL	Legislative Level
LLE	Level of Law Enforcement
LED	Level of Economic Development
TI	Technological Innovation
R&DC	Research and Development Capability
R ²	factor loading squared
QE	Quadratic Effect
KMO	Kaiser-Meyer-Olkin
df	degrees of freedom
RMSEA	Root Mean Square Error of Approximation
CFI	Comparative Fit Index
TLI	Tucker-Lewis Fit Index
SRMR	Standardized Root Mean Square Residual
AVE	Average Variance Extracted
CR	Composite Reliability
HTMT	Heterotrait-Monotrait
FDI	Foreign Direct Investment

CHAPTER 1

INTRODUCTION

1.1 Background and Statement of the Problems

Since entering the new normal, the structure of factor endowment on which China's economic growth relies has changed dramatically, and the crude economic growth mode that used to rely mainly on scale expansion and factor drive at the cost of high input, high consumption and high pollution has become unsustainable, and the importance of innovation-driven development has gradually been highlighted (Gala, 2022). In this case, the national "13th Five-Year Plan" outline puts forward the grand strategy of "innovation-driven" and points out that it is necessary to strengthen the leading position and role of firm innovation. Under the impetus of the national innovation strategy, the innovation investment in firms has been increasing over the years, and the innovation output of firms has also been greatly improved.

For firms in Sichuan Province, China, with the rapid development of the regional economy and the continuous optimisation of the industrial structure, the enhancement of innovation capability is widely regarded as the core driving force for firms' sustainable growth and competition (Chan, 2021). In such a region with rapid economic development and increasing scientific and technological activities, the quality and frequency of firms' innovation activities have a direct effect on the vitality and sustainability of their economic development (Chung, 2021). In this context, the role of intellectual property protection is particularly important, not only as a basic means of safeguarding innovation achievements and promoting technological progress, but also as a key factor in promoting firms' sustainable innovation and technological upgrading (Chen, 2022). Therefore, it is important to explore the effect of intellectual property protection on firm innovation to understand and promote economic development in Sichuan Province and the wider region.

Currently, knowledge and creativity serve as primary drivers behind the growth of modern society, owing to the dynamics of economic globalization and technological advancement. The protection of intellectual property greatly facilitates the promotion of

innovation and the development of intellectual property (Gala, 2022). One of the foremost challenges in China's economic transformation and innovative development has consistently been the protection of intellectual property (Li, 2022). Investigating the impact of intellectual property protection on firm innovation is an important research area, particularly in regions such as Sichuan Province (Cao, 2021).

Awareness of intellectual property protection is critical to stimulating innovation in firms. Awareness of intellectual property protection is fundamental in the innovative ecosystem of firms. The degree of awareness of intellectual property protection among firms in Sichuan Province, their understanding of the legal environment, and their ability to operate in practice all have a direct effect on their willingness and ability to safeguard their innovations (Dai, 2021). A strong intellectual property protection system not only safeguards firms from infringement of their innovations but also enhances their confidence in making long-term R&D investments, thereby promoting technological progress and economic growth in the region as a whole. In Sichuan Province, due to the diverse industrial base and growing demand for innovation (Ding, 2015), it has become particularly important to establish and raise firms' awareness of intellectual property protection. A high level of awareness of intellectual property protection among firms can contribute to the formation of a healthier and more dynamic innovative environment.

Perception of the importance of technological innovation is the key to promoting the continuous progress of firms. In Sichuan Province, the degree of firms' awareness of the importance of technological innovation is directly related to the scale and efficiency of their R&D investment, as well as the formulation and implementation of their innovation strategies (Dong, 2014). Through continuous technological innovation, firms in Sichuan Province can not only enhance the added value of their products and services, but also maintain their leading position in the fierce market competition. A deep understanding of the importance of technological innovation for the success of firms can prompt firms to invest more actively in R&D activities and better respond to market changes and industry competition (Fan, 2012). Therefore, strengthening the awareness of the importance of technological innovation among firm

management and R&D personnel is an important strategy to enhance the overall innovation capability.

The perceived importance of R&D capability is directly related to firms' innovation outcomes. Sichuan firms' perception of the importance of R&D capability determines their strategic choices in talent cultivation, technology accumulation and R&D resource allocation. Under the premise of effective intellectual property protection, firms are more willing to cultivate high-quality R&D teams so as to enhance their R&D capability (Feng, 2020). The more a firm attaches importance to the enhancement of its R&D capability, the more it can seize the first opportunity in the fierce market competition and achieve business growth and market expansion through technological innovation. By enhancing their R&D capability, firms in Sichuan Province are not only able to respond quickly to market changes but also lead the development of new technologies and products, promoting industrial upgrading and economic growth (Ge, 2019).

The measurement of firms' innovative outputs can be categorized into a number of dimensions, the main ones being the following:

1) Direct innovation output indicators:

(1) Number of patents: including the number of patent applications and the number of patents granted, especially the number and percentage of invention patents, which represents the most original innovative output of the firm.

(2) Sales revenue or sales of new products as a proportion of total sales reflects the market acceptance of the firm's new products.

(3) The ratio of new product value added to total value added: reflects the degree of contribution of the enterprise's innovation results to the overall enterprise value.

(4) New products or services: new products created, or new services provided in response to market demand or consumer needs.

2) Innovation input and personnel indicators:

(1) Patents granted per 10,000 R&D personnel: a combination of R&D personnel input and innovation output results.

(2) Technology market turnover per 10,000 science and technology active personnel: reflects the activity of science and technology personnel in the technology market and the trading of innovation results.

(3) Employees entrepreneurial and innovative capacity develops employees entrepreneurial and innovative capacity and encourages them to come up with new ideas and solutions.

3) Market and financial performance indicators:

(1) Market share of new products: Increase in market share through innovation and improvement, expansion and improvement of sales network.

(2) Revenue from main business per capita: although not directly related to innovation output, it can be used as a measure of the overall business performance of the firm.

4) Knowledge innovation indicators:

(1) Knowledge innovation: creating more knowledge about a product, technology or industry, which in turn promotes growth, innovation and progress.

5) technological innovation indicators:

(1) Technological innovation: research and development of new technologies and their use in the firm's related business.

Measures of corporate innovation output cover a wide range of aspects from direct innovation results, innovation inputs and personnel, market and financial performance, knowledge innovation to technological innovation. Together, these indicators constitute a comprehensive framework for evaluating the output of firms' innovative activities.

That the choice of new product market performance as the main indicator of a firm's innovation output was a well-considered decision. New product market performance is an important indicator of a firm's innovation success. Under a strong intellectual property protection system, firms in Sichuan Province are able to launch new products more confidently and realise the commercial success of their products by meeting market demands and following market trends (Guan, 2018). The market performance of new products not only reflects the strength of the firm's innovation ability

but also is a direct reflection of the firm's market competitiveness. Good new product market performance can bring direct economic benefits to firms, enhance their market position, and further promote firms to invest in new innovative projects.

1) Direct market feedback

The new product's market performance reflects most directly the market's acceptance and recognition of the firm's innovations. Consumers express their views on whether a new product meets their needs and is attractive through their purchasing behavior. This direct market feedback provides valuable reference information to help firms understand the market value and potential of their innovations.

2) Commercialization effect of innovation

The ultimate goal of corporate innovation is to achieve commercialization and turn innovations into real economic benefits. The new product's market performance is an important indicator to measure the degree of achieving this goal. Through data such as sales and market share of new products, firms can clearly see the performance of their innovations in the market and then assess the commercialization effect of their innovations. This not only helps firms understand the input-output ratio of innovation but also provides a reference for their future innovation strategy.

3) Embodiment of market competitiveness

The market performance of new products is a direct reflection of the market competitiveness of firms. A new product that can stand out in the market and gain consumers' favor often has strong market competitiveness. This competitiveness comes not only from the innovation of the product, but also from the comprehensive strength of the enterprise's brand, marketing, service and other aspects. Therefore, by evaluating the market performance of new products, firms can understand their own competitive position in the market, so as to formulate more effective market competition strategy.

4) Objectivity and quantifiability

Compared with other measures of innovation output, new product market performance has a higher degree of objectivity and quantifiability. Data such as sales and market share exist objectively and are not easily influenced by subjective factors. At the same time, these data are easy to collect and organize, making it easy for firms to carry

out statistics and analyses. This enables firms to more accurately assess the market performance of their innovations and provides strong support for decision-making.

5) Integrated assessment of innovative outcomes

The new product's market performance is a comprehensive assessment of innovative results. It not only reflects the product's innovativeness, but also the firm's marketing ability, product quality, after-sales service and other factors. A successful new product often requires firms to make efforts in several aspects, such as market research, product design, manufacturing, publicity and promotion. Therefore, by evaluating the new product market performance, firms can gain a comprehensive understanding of the quality and effectiveness of their innovations and provide useful experience and lessons for future innovation activities.

In summary, choosing a new product market performance as the main indicator for measuring the innovation output of an enterprise has the advantages of direct market feedback, the commercialization effect of the innovation, the embodiment of market competitiveness, objectivity and quantifiability, and a comprehensive assessment of the innovation results. This makes new product market performance an indicator that is both comprehensive and accurate in measuring the innovative output of firms.

Intellectual property protection has a non-negligible effect on stimulating the innovation activities of firms in Sichuan Province, enhancing R&D capability, and improving the market performance of new products. An in-depth study of the effect of intellectual property protection on firms' innovation in Sichuan Province has far-reaching effects on stimulating the innovation vitality of firms in Sichuan Province, enhancing their technological innovation ability, strengthening their R&D capability (Han, 2021), and optimizing the market performance of new products. Therefore, an in-depth study of the relationship between intellectual property protection and firm innovation has important theoretical and practical value for firm development.

There is a close relationship between awareness of intellectual property protection and firms' innovation output. Firstly, firms' awareness of intellectual property protection largely affects their innovation activities. Once firms have a high level of awareness of intellectual property protection, they are more inclined to increase their

investment in innovation activities (Li, 2022), because they realize that intellectual property protection is the basis for maintaining innovation achievements. Secondly, a good intellectual property protection system can provide a stable legal environment and guarantee firms' innovations, encouraging them to conduct more R&D activities and improve the quality and quantity of their innovation output. In addition, the continuous improvement and enforcement of relevant policies and regulations also have a positive effect on firms' innovation output, further enhancing their motivation and level of innovation.

There is a close relationship between firms' perceptions of the importance of technological innovation and their innovation output. Firstly, the degree of firms' perception of the importance of technological innovation has a direct effect on the scale and quality of their innovation activities. Firms with higher perceptions of the importance of technological innovation are more inclined to invest more resources in R&D and carry out more forward-looking and strategic innovation projects (Li, 2017), which improves the level and competitiveness of innovation output. Secondly, firms' perception of the importance of technological innovation also reflects their grasp of future market trends and competitive environment. Firms with a deep perception of the importance of technological innovation are more able to accurately insight market demand, seize opportunities, and create more competitive innovative products and services in the market. In addition, a good awareness of intellectual property protection provides institutional safeguards and market environment support for firms to enhance their awareness of the importance of technological innovation, which further stimulates their innovation vitality and promotes the growth of innovation output.

There is an important correlation between firms' perceptions of the importance of R&D capabilities and their innovation output in Sichuan Province. Firstly, firms' perception of the importance of R&D capability has a direct effect on the breadth and depth of their innovative activities (Ji, 2023). Firms with a high level of awareness of the importance of R&D capability are more likely to engage in continuous exploration and innovation in technological innovation, product development, and process improvement, thus enhancing the level and quality of innovation output. Second, firms' perception of

the importance of R&D capability also reflects the extent to which they understand the importance of technological innovation for the long-term development of the firm. A deep understanding of the criticality of R&D capability enhancement to firm success helps firms to pay more attention to talent cultivation, scientific and technological investment and technology accumulation, which in turn enhances the firm's technological innovation capability and competitive advantage (Ma, 2013). In addition, a good awareness of intellectual property protection provides institutional safeguards and market environment support for firms' perception of the importance of R&D capability enhancement, which further stimulates firms' innovation vigor and promotes the growth of firm innovation outputs.

As one of the important provinces in western China, Sichuan Province has seen rapid economic development and increasingly frequent scientific and technological activities, and thus the innovative activities of firms have an important effect on regional economic development. In this context, exploring the effect of intellectual property protection on firm innovation in Sichuan Province is of great significance for a deeper understanding of the relationship between intellectual property protection and firm innovation, as well as for the promotion of sustainable regional economic development. These issues provide the foundation and framework for the research of this paper. Based on the above research background and research problem statement, this paper will study how intellectual property protection affects firm innovation in Sichuan Province.

1.2 The Purpose of this Research

Although intellectual property protection and firm innovation come from two different disciplines, they are closely related. Intellectual property protection is both a legal and a regulatory concept, and each country has its own institutional framework. However, at the same time, it is closely related to firm innovation, which is affected by other factors, and is a hot global issue with many contents and wide coverage (Ge, 2019). This study focuses on how intellectual property protection affects firm innovation outputs. The following are the main research objectives of this topic.

1.2.1 In Order to Elucidate the Relationship between Intellectual Property Protection and Firm Innovation in Sichuan Province

Intellectual property protection plays an important role in promoting the innovation and competitiveness of firms, and the degree of awareness of intellectual property protection by firms directly affects the development of their innovative activities and the transformation of their achievements (Ge, 2019). Intellectual property protection has become an important support and guarantee for firms' innovative activities. Therefore, it is of great theoretical and practical significance to deeply explore the effect mechanism of intellectual property protection awareness on firm innovation (Ji 2023). This study aims to reveal the effect of awareness of intellectual property protection on firm innovation outputs by analyzing the relationship between the degree of awareness of intellectual property protection by firms and their innovation activities.

1.2.2 Investigating the Impact of Intellectual Property Protection on Firm Innovation Outputs through Technological Innovation

Technological innovation has become one of the core elements of corporate competition, while intellectual property protection is an important safeguard mechanism to guarantee the results of technological innovation and to motivate firms to carry out innovative activities. This paper explores the effect of intellectual property protection awareness on firm innovation outputs through the perception of the importance of technological innovation, specifically, by analyzing the relationship between the level of awareness of intellectual property protection by firms and their perception of the importance of technological innovation (Ge, 2019), in order to reveal how the awareness of intellectual property protection influences firm innovation outputs by affecting the perception of the importance of technological innovation.

1.2.3 Exploring the Influence of Intellectual Property Protection on Firm Innovation Outputs through Firm R&D Capability

The R&D capability of firms is the key to realizing innovation. And intellectual property protection, as an important means of protecting firm innovations, has an important effect on firm R&D capability and innovation outputs (Ji, 2023). Specifically, this paper aims to analyze the extent to which intellectual property protection affects

firms' R&D capabilities and the mechanism by which R&D capability affect firms' innovation outputs, so as to reveal how intellectual property protection affects firms' innovation outputs through firms' R&D capability.

These research objectives were derived from the literature review of previous studies, and the methodology used in this study included the development of specific research hypotheses and the collection of data from firms by means of questionnaires and interviews, as well as the statistical analyses of the collected data.

1.3 Research Questions and Hypotheses

This study investigates the influence of corporate Intellectual Property Protection (IPP) on firm innovation output, particularly examining how IPP affects firm innovation through two pathways: the perceived importance of technological innovation and the significance of R&D capability. The research questions are as follows:

RQ1: What impact does firm intellectual property protection have on firm innovation outputs?

RQ2: Does technological innovation mediate the relationship between intellectual property protection and firm innovation outputs?

RQ3: Does R&D capability mediate the relationship between intellectual property protection and firm innovation outputs?

Consequently, the following hypotheses have been proposed.

1.3.1 Hypotheses on the Relationship between Intellectual Property Protection and Firm Innovation Outputs

Firm innovation outputs can directly reflect firm innovation. Gala (2022) shows that the relationship between intellectual property protection and firm innovation outputs is in an inverted U-shape, the relationship between intellectual property protection and firm innovation outputs must be at the upper limit, which indicates that intellectual property protection is stronger. If intellectual property protection is too strong and on the right side of the peak, it will increase the difficulty of firm innovation and hinder the development of firms. (Weng, 2019) There is no doubt that moderate intellectual property

protection contributes to firm innovation outputs, although there are some differences in the current academic research on this topic.

Based on the aforementioned conclusions, this study proposes the following research hypothesis:

H1: Intellectual property protection and firm innovation outputs are related and have an inverted U-shaped relationship.

1.3.2 Hypotheses on the Role of Technological Innovation as a Mediator of Intellectual Property Protection for Firm Innovation Outputs

In Han's (2021) study, technological innovation as a mediating mechanism plays an important role in the relationship between intellectual property protection and firm innovation outputs. Technological innovation is not only an important result of intellectual property protection, but also one of its driving forces. Firstly, a good intellectual property protection system can encourage firms to increase their investment in technological innovation, because firms are more willing to conduct long-term R&D activities under the premise of intellectual property protection in order to gain technological advantages and protect their innovations. Secondly, technological innovation helps to enhance the competitiveness and market position of firms, which in turn strengthens their demand for and awareness of intellectual property protection. At the same time, through continuous technological innovation, firms can continuously update and improve their Intellectual Property portfolios to further consolidate their market position (Ji, 2023). Therefore, technological innovation plays an important intermediary role between intellectual property protection and firm innovation outputs, and by strengthening the implementation and enforcement of intellectual property protection, it will in turn promote the technological innovation activities of firms and enhance the level of innovation outputs.

Based on the aforementioned conclusions, this study proposes the following research hypothesis:

H2: Technological innovation mediates the relationship between intellectual property protection and firm innovation outputs.

1.3.3 Hypotheses on the Role of R&D Capabilities as Mediators of Intellectual Property Protection for Firm Innovation Outputs

In the study of Sheng (2023), R&D capability plays an important role as a mediating mechanism in the relationship between intellectual property protection and firm innovation outputs. R&D capability is the basis for firms to carry out technological innovation and innovative activities, and it is also an important object and result of intellectual property protection. Firstly, a good intellectual property protection system helps to enhance firms' motivation and investment in innovation, as firms are more inclined to increase their investment in R&D activities on the premise that their intellectual property rights are effectively protected. Secondly, the improvement of R&D capability can enhance firms' demand and awareness of intellectual property protection. Through continuous R&D activities, firms can not only improve their innovation capability, but also better protect and utilize their intellectual property protection, thus enhancing market competitiveness. At the same time, effective intellectual property protection also provides firms with a stable innovative environment and market security, further stimulating their R&D activities and innovative drive. Thus, R&D capacity acts as an important intermediary between intellectual property protection and firm innovation outputs, and by strengthening the implementation and enforcement of intellectual property protection, it in turn promotes the R&D activities and innovation outputs of firms and promotes sustainable economic development.

Based on the aforementioned conclusions, this study proposes the following research hypothesis:

H3: R&D Capability mediates the relationship between intellectual property protection and firm innovation outputs.

1.4 Scope of Study

For the study, Chengdu City in Sichuan Province and Zigong City in Sichuan Province are chosen as two representative cities. State-controlled firms and private firms are examples in the Sichuan Province cities of Chengdu and Zigong.

Chengdu City, as a new first-tier city in Sichuan Province, performs well and has a high level of intellectual property protection. Chengdu focuses on intellectual property protection and legal system construction and is committed to improving the strength and quality of intellectual property protection. The government has strengthened intellectual property enforcement and provided a number of policies and measures to encourage firm innovation and intellectual property protection. This environment provides better protection and support for firm innovation. In addition, Chengdu is rich in innovative resources and talent concentration. The city has a number of high-level universities and research institutes, which provide firms with a wealth of research results and professional talents. Meanwhile, Chengdu has also attracted a number of high-tech firms and innovative firms, formed an innovative ecosystem and promoting the gathering and sharing of innovation resources. (Liu, Lei, Jiang, Hu, & Li, 2019)

In summary, Chengdu, as a new first-tier city in Sichuan Province, excels in high levels of intellectual property protection, clustering of innovative resources, innovative atmosphere and policy support. Together, these factors have contributed to the enhancement of firms' innovative efforts and facilitated the rapid development of the economy and the upgrading of industries. The innovation environment in Chengdu provides favorable conditions for firm innovation and contributes positively to sustainable socio-economic development.

As an old, industrialized city in Sichuan Province, Zigong may be relatively backward in terms of its level of IPP compared to other areas in Sichuan Province. Due to the relatively early industrialization of Zigong, the awareness of intellectual property protection is relatively weak. In some traditional industrial areas, especially the traditional heavy industries in Zigong, there may be a lack of awareness of intellectual property protection and a low level of emphasis on technological innovation. Compared to new first-tier cities such as Chengdu, Zigong may have invested less in technological innovation. This may be due to the relatively limited resources and funding, as well as the low importance that firms place on innovation. This may result in firms in Zigong City lagging behind relatively in terms of technological research and development, new product development and innovation capabilities. (Wu, Jiang, & Tim, 2022)

The industrial structure of Zigong is relatively homogeneous, dominated by traditional heavy industry. This may limit the development of firms in Zigong in terms of technological innovation and new industries. The relatively less diversified industrial structure may limit the innovation drive and innovation capacity of firms. Although Zigong may be relatively backward in terms of intellectual property protection and firm innovation efforts, with socio-economic development and policy support, Zigong is gradually strengthening intellectual property protection and promoting firm innovation. (Wu, Jiang, & Tim, 2022)

This paper selects two representative cities in Sichuan Province, which is sufficient to reflect the overall level of Sichuan Province. And there is usually a difference in firm innovation between state-controlled firms and private firms.

State-controlled firms usually have stronger financial and resource support and can invest more funds and resources in innovation, with the State directly or indirectly holding a controlling stake, and the State usually holds an absolute or relative majority of shares in the firm. There is usually state involvement in important decision-making and strategic planning, and the state may participate in the decision-making process of the firm by appointing directors or in other forms. Often orientated towards the public interest, in addition to pursuing economic profits, they also take on social responsibility, focusing on goals such as social stability, employment and public services. Their innovation model often relies on internal R&D capabilities and resource integration to drive innovation through independent research and development of new products, technologies and services. State-controlled firms may also use cooperation with institutions such as the government and universities, as well as importing technology from abroad and co-development, to innovate. (Li, & Wang, 2020)

Private firms are usually characterized by greater flexibility, speed and market sensitivity. They are usually market-oriented and pursue economic efficiency and profitability. They base their business decisions and product development on market demand to gain profits and market share and prefer to innovate based on market opportunities. They often adopt a rapid trial-and-error and iterative approach, constantly experimenting with new products, new business models and innovative solutions in the

market. Compared to state-controlled companies, private companies are usually more flexible and innovative. They are able to adapt more quickly to market changes and adopt flexible business strategies and decisions to meet market demands and pursue competitive advantages. Private firms also tend to collaborate with innovative start-ups, research institutes and universities to access external innovation resources and cooperation opportunities. (Chan, 2021)

Additionally, innovation patterns in state-controlled and private businesses may diverge and overlap. A fuller understanding of the advantages and disadvantages of both in the area of innovation, as well as targeted innovation support and policy recommendations for various types of organizations, can be gained by comparing and contrasting the innovation models of state-controlled and private businesses. In order to promote comprehensive innovation-driven sustainable development, more research might examine the consequences of various innovation models and their contribution to economic development.

Table 1.1 Number of state-controlled and private firms in two cities

City	Number of state-controlled firms	Number of private firms (10,000)
Chengdu	3.5	541.2
Zigong	0.44	17.27

Note: Data as of the end of 2022, the number of units is 10,000 households.

Reference: Data released by Chengdu Municipal Government; data released by Zigong Municipal Government.

Based on the availability of data, this study chooses state-controlled and private firms in Chengdu and Zigong, Sichuan Province, as its samples. Find the data sources that are available, such as government agencies, business associations, commercial databases, research reports, etc. Analyze the data's accuracy, dependability, and coverage. Based on the study's objectives and the quantity of data at hand, choose the right sample size.

For this investigation, a questionnaire will be carried out. Respondents rate their agreement with the description of the question item's content on a five-point Likert scale between 1 and 5, with higher scores indicating greater agreement.

1.5 Terms Definition

Intellectual Property Protection (IPP): Intellectual property protection refers to the awareness and behavior of an individual, an organization or a state that is aware of the importance and value of intellectual property and takes a series of measures to protect and safeguard the legitimate rights and interests of intellectual property. This awareness covers the understanding of the concept of intellectual property and the perception of the necessity and importance of intellectual property protection. In the academic field, awareness of intellectual property protection emphasizes the compliance with and respect for intellectual property laws and regulations on the part of knowledge creators and knowledge users, as well as their ability to be alert to and counteract intellectual property infringements.

Legislative Level: Legislative level refers to the completeness and quality level of laws and regulations in the field of intellectual property in a country or region. This includes the laws, regulations, ordinances, policy documents, etc. related to intellectual property rights enacted by the country or region, as well as the formulation, revision and implementation of these laws and regulations. Legislative level is one of the important indicators for assessing the awareness of intellectual property protection in a country or region. It reflects the degree of understanding of intellectual property laws by firms in the country or region.

Level of Law Enforcement: The level of law enforcement is the level of quality and efficiency of law enforcement practices in the field of intellectual property in a country or region. The level of law enforcement is one of the important indicators for assessing the effectiveness of intellectual property protection and the rule of law environment in a country or region. Explaining the level of law enforcement of intellectual property from the perspective of firms' understanding of intellectual property

law emphasizes their understanding of intellectual property law, as well as their perception and evaluation of the effectiveness of enforcement.

Level of Economic Development: The level of economic development is the extent to which a country or region is aware of intellectual property protection and innovation activities, as well as the importance it attaches to intellectual property at the legal, policy and institutional levels, and its impact and influence on economic development. The level of economic development is one of the key indicators for assessing the economic growth and scientific and technological innovation capacity of a country or region. In assessing the level of economic development of intellectual property, it is necessary to take into account factors such as the prevalence of awareness of intellectual property protection and the application and transformation of intellectual property in a country or region.

Technological innovation: Technological innovation refers to the process of creating new technologies, products, services or production methods through continuous improvement, change and application on the basis of scientific knowledge and technology. Cognition of the importance of technological innovation emphasizes the importance and level of awareness of individuals and organizations of technological innovation, as well as their perception of the important role of technological innovation for the development of individuals, organizations and society. This perception has a facilitating effect on stimulating the innovation vitality of individuals and organizations and can promote the development of scientific and technological research and technology application and promote economic growth and social progress.

Research and Development (R&D) capability: R&D capability refers to the ability and resources of a firm or organization in the field of scientific and technological R&D, including support and investment in human, financial and material resources, as well as the comprehensive strength of organizational structure, management system and technological innovation capability. The perception of the importance of R&D capability emphasizes the extent to which firms perceive the importance of R&D capability and attach importance to R&D investment. A firm's full cognition of R&D capability can clarify the firm's innovation strategy and development direction, stimulate internal

innovation motivation, and improve the efficiency and effectiveness of technological innovation and product development.

Firm Innovation Outputs: Firm innovation outputs refer to the new products or services produced by firms through technological innovation, product development and other innovation activities, as well as the performance and impact of these new products or services in the market. Firm innovation outputs are not only about the launch of products or services, but more importantly about their acceptance and impact in the market. The market performance of new products directly reflects the results and effects of the firm's innovation activities and is also an important manifestation of the firm's innovation capability and competitiveness. Good new product market performance can bring competitive advantages and economic returns to the firm, improve its market position and brand value, and promote its sustainable development.

State-controlled firms: firms that are either controlled or majority-owned by the State. These firms have State participation or control in both ownership and decision-making.

Private firms: firms that are owned, controlled and operated by private individuals or private collectives. These firms are privately owned and controlled in terms of ownership and decision-making power.

1.6 Research Framework

Starting from the framework diagram, the researcher develops this concept in the study "Effect of Intellectual Property Protection on Firm Innovation in Sichuan Province" and shows the relationship between the theoretical frameworks as follows:

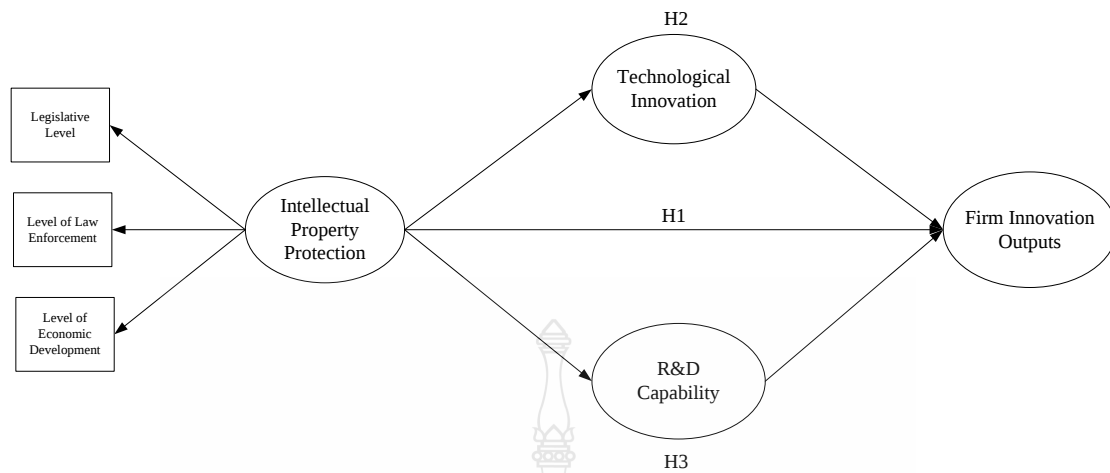


Figure 1.1 Research framework

1.7 Organization of the Study

This study consists of five chapters.

Chapter 1: Introduction, presents the background and statement of the problem of this study, including the research objectives, research questions, hypotheses and conceptual framework, and the scope of this study.

Chapter 2: Literature Review lays the theoretical and empirical foundations for this study based on a review of previous research in related areas. This chapter aims to review each of the main theoretical concepts used in research work in the area of intellectual property management and firm innovation outputs, including the level of legislation level of law enforcement, the level of economic development, technological innovation, and R&D capabilities.

Chapter 3: Research Methodology presents the methodology relevant to this study based on the research questions, research hypotheses and literature reviewed in Chapters 1 and 2. Relevant topics are the research design, survey methodology, sampling plan, measurement properties of the selected scales, data analysis plan and quantitative measurement. Special attention was given to testing the validity and reliability of the research constructs.

Chapter 4: Data Analysis, the results presented in this chapter. The data from the quantitative survey was analyzed and presented. This included analysis of the

reliability and validity of the constructions. Hypothesis testing and a summary of the findings are reported to the extent that the hypothesized relationships occurred.

Chapter 5: Summary and Conclusions, this chapter presents the conclusions of the findings from both theoretical and practical perspectives, including a discussion of the research, theoretical contributions, managerial contributions, limitations, and recommendations for future research.



CHAPTER 2

REVIEW OF THE LITERATURE

In-depth analysis of the influence of intellectual property protection (IPP) on business innovation in Sichuan Province is provided in this research. The pertinent literature that is now available can be broadly divided into three areas. The first category of literature focuses on studies on techniques for determining the level of IPP; the second category discusses the various effects of IPP on firm innovation at various stages of economic development; and the third category of literature is concerned with the effects of IPP on firm innovation. Based on the three literature evaluations mentioned above, a review of pertinent literature was done; a quick summary of the current literature is provided in the chapter's concluding part.

2.1 Current Status of Research on IPP and Firm Innovation

2.2 Surveys and research on intellectual property protection

2.3 Literature on intellectual property protection

2.4 Literature on the role of intellectual property protection in firm innovation outputs through technological innovation

2.5 Literature on the role of R&D capabilities in firm innovation outputs through intellectual property protection

2.6 A Literature Study on the Inverted U-Shaped Relationship between Intellectual Property Protection and Firm Innovation Outputs

2.7 Differences in the impact of intellectual property protection on firm innovation outputs between state-controlled and private firms

2.8 Literature related to questionnaires

2.9 Review of Related Literature

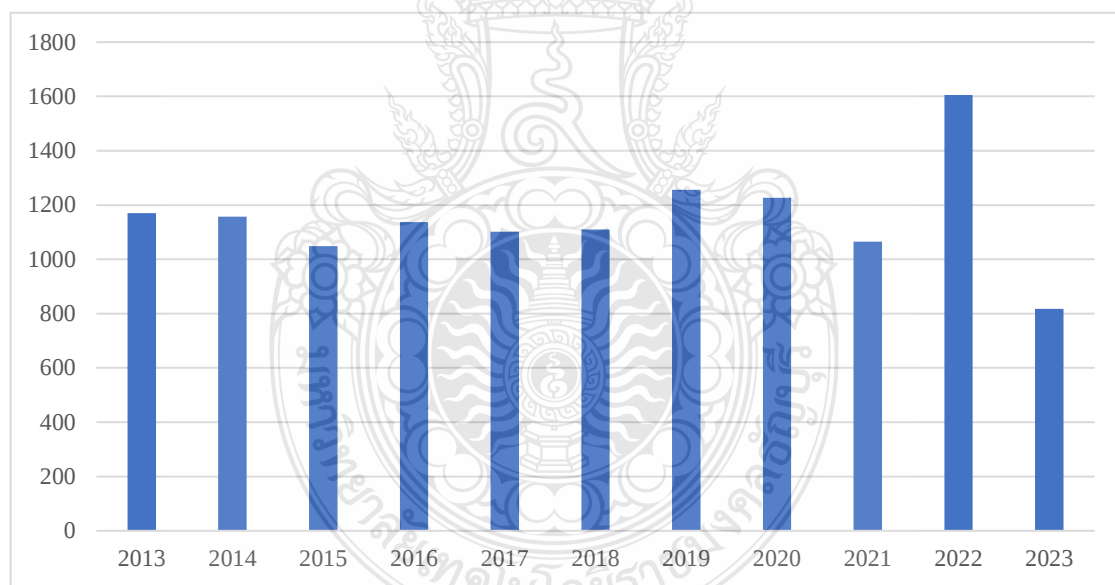
2.10 Brief Review of the literature

2.1 Current Status of Research on IPP and Firm Innovation

For the economic and social development of a country, intellectual property protection is a crucial tool for encouraging firm innovation and technological

advancement. The preservation of intellectual property rights has become a major priority in China as a result of the country's rapid economic growth and advancements in science and technology.

On China Knowledge Network Database (CNKI)¹, the researcher looked for publications about intellectual property protection and discovered 12,695 total articles over the previous ten years. In a given year, 1,154 articles are typically published. This demonstrates that the research community is quite active, and that intellectual property protection has gained extensive attention in both academia and industry. Intellectual property protection is gradually gaining more acceptance in Chinese society. As awareness of the need to preserve intellectual property rights grows, more businesses and people are taking the initiative to file for patents, trademarks, and copyrights. Through a variety of media campaigns and educational initiatives, the government has increased public awareness of intellectual property protection and its significance.



Data source: CNKI

Note: Statistics as of June 2023

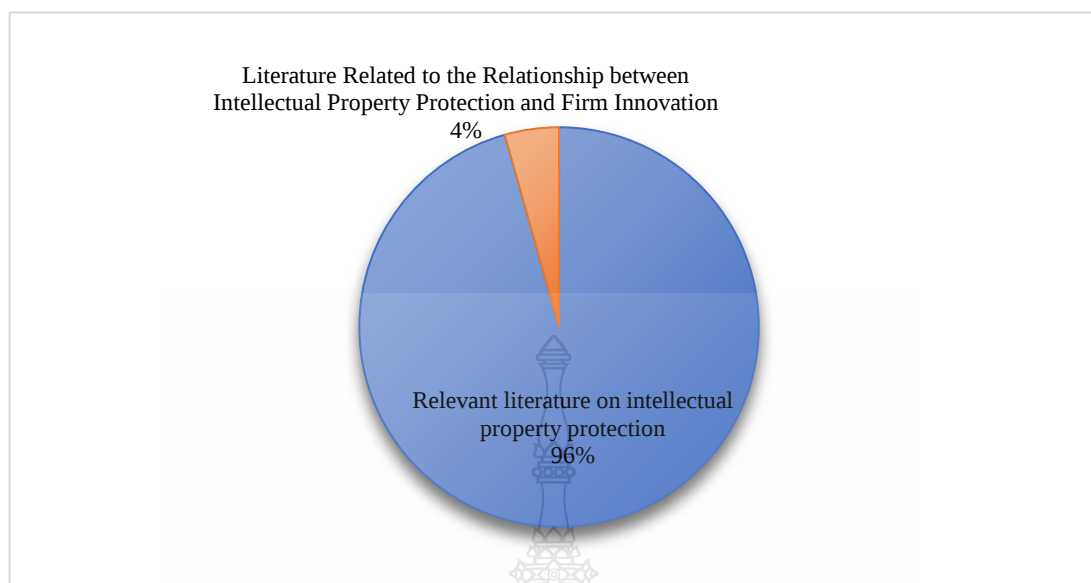
Figure 1.1 List of literature on IPP in the last ten years

¹ www.cnki.net

Governments, firms, and international organizations are now actively taking steps to protect the rights and interests of intellectual property, making intellectual property protection an essential issue on a worldwide scale. This broad breadth of study interest and focus highlights how crucial intellectual property rights are to innovation, technological advancement, and economic growth. The amount that Chinese businesses invest in R&D capability and innovation keeps rising. The government has implemented a number of laws and measures to encourage technological and scientific innovation, which has increased businesses' incentive to develop. More businesses are starting to enhance the connection between intellectual property rights and scientific and technical innovation by including intellectual property protection into their strategic planning.

Firm innovation has been significantly impacted by intellectual property protection, which not only encourages businesses to invest in innovation but also helps them maintain their competitive edge in the market. firms can better foster technical innovation, improve competitiveness, and foster economic development and social progress through effective intellectual property protection. In order to promote the value of intellectual property protection, provide a solid legislative framework and enforcement mechanism, and improve the environment and support for firm innovation, both governments and businesses should collaborate.

A total of 581 publications have been published on the subject of how intellectual property protection affects corporate innovation between 2013 and 2023, according to statistics from the CNKI. This suggests that Chinese academics haven't explored the connection between company innovation and intellectual property protection in depth enough over the previous ten years.



Data source: CNKI

Note: Statistics as of June 2023

Figure 2.2 Research on the relationship between IPP and firm innovation as a proportion of IPP

Although there is still some room for improvement in the research on the relationship between intellectual property and firm innovation, there are currently published research articles covering the impact of intellectual property protection on many aspects of firm innovation investment, technological innovation, and market competition, which provide an important reference for us to understand and promote.

Researchers, business decision-makers, and legislators can all benefit from the findings of these investigations. We can better understand the function of intellectual property protection in encouraging firm innovation, boosting technological advancement, and fostering economic development through in-depth research on the relationship intellectual property between intellectual property protection and firm innovation.

2.2 Surveys and Research on Intellectual Property Protection

It is vital to give a reasonable indication of the amount of intellectual property protection in order to investigate how it affects corporate innovation. In this essay, the literature on measuring the degree of intellectual property protection is reviewed.

Based on the findings of a poll of respondents, the survey method, often referred to as the subjective evaluation method, is used to assess the degree of intellectual property protection in the area. Table 2.1 provides examples. A survey-based approach is also used to calculate the level of intellectual property protection in The Global Competitiveness Report, which is issued yearly by the World Economic Forum (WEF). Based on the respondents' perceptions of the amount of intellectual property protection in the target region, the level of intellectual property protection in each region is assessed on a scale of 1–7, with higher scores indicating a higher level of intellectual property protection. Many scholars prefer the survey-based data on intellectual property protection because it is closer to the actual protection, particularly the WEF data, which has been extensively used in studies by Yang, & Huang, (2009), Weng, Huang, & Yi, (2009), Dong, & Zhuang, (2014), and Weng, (2019), and Dai, (2014), among others.

Table 1.1 Scholars and content related to survey methodology

Relevant Academics	Forms of Research	Research Content
Mansfield (1995)	Questionnaire Survey	Surveyed 180 managers and patent attorneys from the United States, Japan and Germany on their satisfaction with the level of intellectual property protection in 14 more technologically advanced developing countries.
Sherwood (1997)	Field Survey	Surveyed the level of intellectual property protection in 18 countries.

Source: CNKI.

Processing by: researcher

2.3 Literature on Intellectual Property Protection

In terms of firms' attitudes towards the legal system for intellectual property protection, studies over the past few years have provided rich literature. In this paper, we will review the literature on the impact of intellectual property protection on firm innovation outputs and discuss it from the perspective of firms' attitudes towards the legal system of intellectual property protection.

Firstly, Ge's (2019) study looks at the improvement of China's intellectual property rights legal system, emphasizing the improvement of the legal system under the perspective of intellectual property rights strategy. He points out that with the development of China's economy and the intensification of globalized competition, firms are paying increasing attention to intellectual property protection. Therefore, strengthening the legal system of intellectual property is one of the important ways to improve firm innovation outputs.

Secondly, Wu's (2019) study explores the path of modernization of the intellectual property legal system from the development path of China's intellectual property legal system. He argues that with the continuous development since China's reform and opening up, the legal system of intellectual property rights has been improved and modernized, providing a more stable and reliable legal guarantee for firms' innovation.

In addition, Liu's (2019) study focuses on the impact of the intellectual property legal system on technological innovation. He explored the role of intellectual property protection in stimulating technological innovation, pointing out the importance of a good intellectual property legal system for firms' technological innovation activities. Firms' recognition and support of the intellectual property protection legal system helps to increase their motivation and confidence to engage in technological innovation, which in turn contributes to the growth of firm innovation outputs.

Finally, Feng's (2020) study reflects on the intellectual property legal system with Chinese characteristics. He argues that China has made some achievements in the construction of its intellectual property legal system but also faces some challenges and problems. Therefore, there is a need to further improve and develop the intellectual

property legal system in order to better support firms' innovative activities and increase the level of innovation outputs.

In summary, firms have a positive attitude towards the legal system of intellectual property protection, believing that a good legal system can provide a stable legal environment and protection, stimulate firms to carry out technological innovation activities, and thus promote the growth of innovation outputs. However, there is a need to continuously improve and develop the legal system to cope with the increasingly complex innovative environment and challenges and to provide stronger support for firms' innovation and development.

The formation and impact of firms' legal awareness of intellectual property protection is an important research topic from the perspective of the level of enforcement of intellectual property protection. A literature review is conducted to show the impact of legal awareness of intellectual property protection on firm innovation outputs from the perspective of regional economic levels.

First, Li's (2017) study reveals the impact of the enforcement level of intellectual property protection on firms through metrics analysis. He points out that a higher level of enforcement protection can effectively safeguard firms' intellectual property rights, enhance firms' legal awareness of and attention to intellectual property rights, and then promote firm innovation outputs.

Second, Zhou's (2020) study focused on trade secret protection in China and the United States. He found that there are differences in the level of trade secret protection in different countries, which directly affects the legal awareness and behaviour of firms. A good trade secret protection system can increase firms' awareness of intellectual property legality and make them pay more attention to the protection and use of intellectual property, thus promoting the growth of innovation outputs.

In addition, a study by Han, & Xu, (2021) examines the relationship between intellectual property protection and foreign investment. They find that a higher level of intellectual property protection attracts more foreign investment, improves firms' legal awareness and compliance, and thus promotes the growth of innovative outputs.

In summary, the level of enforcement of intellectual property protection has a significant impact on the legal awareness and behaviors of firms. A higher level of enforcement protection can improve firms' awareness of and attention to intellectual property law and promote the growth of firm innovation outputs. Therefore, the government should strengthen the supervision and management of the enforcement level of intellectual property protection to provide stronger legal protection and support for the innovative development of firms.

From the perspective of the level of economic development, legal awareness of intellectual property protection has different effects on firm innovation outputs in different regions. A literature review is conducted to show the impact of legal awareness of intellectual property protection on firm innovation outputs from the perspective of the level of economic development.

Firstly, a study by Zhao, & Cao, (2017) explores the interaction between intellectual property capacity and the level of economic development. They found that in Jiangsu Province, a higher level of intellectual property protection can effectively promote economic development and positively affect firm innovation outputs. A high level of legal awareness of intellectual property protection makes firms pay more attention to the protection and use of intellectual property, which increases the motivation of innovation activities and the level of firm innovation outputs.

Second, a study by Guan, Yuan, & Yu, (2018) explored the relationship between innovation drive, intellectual property protection, and regional economic development. They found that there is a threshold effect on the impact of legal awareness of intellectual property protection on firm innovation outputs in regions with different levels of economic development. In regions with higher levels of economic development, higher levels of legal awareness of intellectual property protection can better promote the growth of firm innovation outputs.

Finally, the study by Li, & Wang, (2020) explored the relationship between the intensity of intellectual property protection and the level of economic development based on fuzzy preference modelling. They found that the intensity of intellectual property protection shows a certain positive correlation with the level of regional economic

development and that a higher level of intellectual property protection helps to improve the level of regional economic development and promotes the growth of firm innovation outputs.

In summary, the impact of legal awareness of intellectual property protection on firm innovation outputs is closely related to the level of regional economic development. In regions with different levels of economic development, a higher level of legal awareness of intellectual property protection can better promote the growth of firm innovation outputs and provide strong support for the sustainable development of the regional economy. Therefore, the government and firms should strengthen the cultivation and propaganda of legal awareness of intellectual property protection so as to provide stronger legal protection and support for firms' innovative development.

From the perspective of the level of law enforcement and social rule of law, the legal awareness of intellectual property protection has a far-reaching impact on the level of social rule of law. This paper will demonstrate the impact of legal awareness of intellectual property protection on the level of rule of law in society and firm innovation outputs from the perspective of the level of rule of law in society through a literature review.

Firstly, Wu's (2019) study considers the development path of China's intellectual property legal system from a number of aspects since the reform and opening up. He points out that the improvement of the level of the rule of law in society is crucial to the legal awareness of intellectual property protection. As the level of the rule of law in society continues to improve, social awareness of intellectual property protection gradually increases, which promotes the effective protection and use of intellectual property rights, which in turn promotes the growth of firm innovation outputs.

Second, Zhou's (2020) study focused on trade secret protection in China and the United States. He found that differences in the level of rule of law in society directly affect the effectiveness of intellectual property protection and the level of firm innovation outputs. In societies with higher levels of rule of law, legal awareness is more prevalent and intellectual property protection is better enforced, providing firms with a more stable and reliable innovative environment.

In addition, Feng's (2020) study reflects on the judicial practice of intellectual property rights in the new era of Chinese characteristics. He points out that the improved level of the rule of law in society has contributed to the professional and standardized development of intellectual property justice, provided more effective legal protection for firms, and enhanced firms' legal awareness of intellectual property protection, thus promoting the growth of innovative outputs.

Finally, a study by Han and Xu, & Sun, (2019) examines the relationship between intellectual property protection and foreign investment. They find that a higher level of social rule of law attracts more foreign investment, provides firms with a more stable and reliable legal environment, and promotes the growth of firm innovation outputs.

In summary, the level of the rule of law in society has a significant impact on legal awareness of intellectual property protection and firm innovation outputs. A higher level of social rule of law can increase the importance of intellectual property protection in society and provide a more stable and reliable legal environment for firms, thus promoting the growth of firm innovation outputs. Therefore, the government and society should strengthen the cultivation and propaganda of legal awareness of intellectual property protection, promote the continuous improvement of the level of social rule of law, and provide more powerful legal protection and support for the innovative development of firms.

Legal awareness of intellectual property protection is important for the monitoring and balancing mechanisms of the international community from the perspective of the monitoring and balancing mechanisms of the international community at the legislative level. The impact of legal awareness of intellectual property protection on the monitoring and balancing mechanisms of the international community is demonstrated and discussed from this perspective through a literature review.

First, Li (2017) conducted a metric analysis of the level of enforcement of intellectual property protection. He pointed out that the monitoring and balancing mechanisms of the international community can prompt countries to strengthen their legal awareness and enforcement of intellectual property protection. Through the supervision

and coordination of international organizations and multilateral agreements, countries can be pushed to establish a more sound and effective intellectual property protection system, providing the international community with a more stable and reliable intellectual property protection environment.

Second, the study by Guan, Yuan, & Yu, (2018) explored the relationship between innovation drive and intellectual property protection based on regional economic development data. They found that the monitoring and balancing mechanisms of the international community can further promote regional economic development and innovation capacity by promoting legal awareness and enforcement of intellectual property protection and achieving sustainable economic development.

Finally, Li, & Wang, (2020) studied the relationship between the intensity of intellectual property protection and the level of economic development based on fuzzy preference modelling. They found that the monitoring and balancing mechanisms of the international community can push countries to strengthen their legal awareness and enforcement of intellectual property protection, thus increasing the intensity of intellectual property protection and promoting economic development and the growth of innovation output.

In summary, legal awareness of intellectual property protection is of great significance to the monitoring and balancing mechanisms of the international community. Through the supervision and coordination mechanism, the international community can prompt countries to strengthen their legal awareness and enforcement of intellectual property protection, which will in turn promote economic development and the growth of innovation output. Therefore, the international community should strengthen the supervision and coordination of intellectual property protection and build a more stable and sound intellectual property protection system, so as to provide strong support for the development and innovation of the global economy.

Table 2.2 Indicator system for enforcement effort

Indicator System	Relevant Academics
Degree of Completeness of the Legal System	Ge, S. F. (2019) Wu, F. (2019) Liu, H. (2019) Feng, X. Q. (2020)
Enforcement Level	Li, P. (2017) Zhou, P. (2020) Han, J., & Xu, Y. Y. (2021)
Level of Economic Development	Zhao, X. C., & Cao, A. L. (2017) Guan, C. H., Yuan, X. F., & Yu, X. L. (2018) Li, M. M., Gao, Y., Lu, T., Jia, Q. L., & Jing, W. (2020)
Level of Rule of Law in Society	Wu, F. (2019) Zhou, P. (2020) Feng, X. Q. (2020) Han, J., & Xu, Y. Y. (2021)
Monitoring and Balancing Mechanisms of the International Community	Li, P. (2017) Guan, C. H., Yuan, X. F., & Yu, Xi. L. (2018) Li, M. M., Gao, Y., Lu, T., Jia, Q. L., & Jing, W. (2020)

Source: CNKI.

Processing by: Researcher.

2.4 Literature on the Role of Intellectual Property Protection in Firm Innovation Outputs through Technological Innovation

The impact of intellectual property protection on firm innovation outputs is significant from the perspective of technological innovation. This paper will discuss the impact of intellectual property protection on firm innovation outputs through technological innovation from the perspective of technological innovation through a literature review.

First, Lin's (2024) study delves into the relationship between intellectual property protection, factor allocation efficiency, and firms' green technological

innovation. In his study, he concludes that good intellectual property protection not only improves the efficiency and cost-effectiveness of technological innovation but also promotes firms' green technological innovation and injects a new impetus into firm innovation outputs.

Secondly, Ren, Liu, Zhao, Hu, & Li.'s (2023) study focuses on the impact of big data development and intellectual property protection on firms' green technology innovation. According to their study, the rapid development of big data technology brings new opportunities and challenges for firms. At the same time, the full protection of intellectual property helps to protect the technological innovation achievements of firms, which in turn promotes the green technological innovation of firms.

In addition, Liu's (2023) study explored the relationship between intellectual property protection, the digital economy and firms' disruptive technological innovations. He emphasized how the booming digital economy has provided new platforms and channels for firms' technological innovation, while at the same time, good intellectual property protection has played a key role in protecting firms' disruptive technological innovations, thus facilitating firms' innovation output.

Finally, Li, Li, & Zhang,'s (2023) study explored the link between the construction of digital China, intellectual property protection and firms' technological innovation. His study found that the construction of digital China brings new opportunities and challenges for firms' technological innovation, while good intellectual property protection can also protect firms' technological innovation achievements, which in turn promotes firms' technological innovation output.

Many studies have examined the impact of technological innovation on firms' income from sales of new products. Most of the studies show that technological innovation has a positive impact on new product development. The results of some empirical studies show that firms with higher levels of technological innovation tend to develop new products with market competitiveness more effectively. For example, Wang, Luo, Shi, & Liu, (2018) found in a study of firms in an industry that technological innovation helps to increase the success rate of new product development, reduce development costs, and shorten the development cycle.

In summary, the impact of intellectual property protection on firms' innovation output through technological innovation is far-reaching. Good intellectual property protection can promote the development of technological innovation, provide firms with a favorable innovation environment and guarantee, and then promote the growth of firms' innovation output. Therefore, governments and firms should pay more attention to intellectual property protection, improve the efficiency and cost-effectiveness of technological innovation, and provide better support and guarantee for the innovative development of firms.

2.5 Literature on the Role of Intellectual Property Protection in Firm Innovation Outputs through R&D Capabilities

In a study on the impact of technological innovation and firm R&D capability on the market performance of new firms, it was found that technological innovation and firm R&D play an important role in promoting the sales revenues of new firms by combining and assessing the relevant literature. In today's competitive market environment, technological innovation and firm R&D have become key factors for the sustainable development of enterprises. Firms continue to introduce new products through technological innovation and R&D activities to meet market demand and maintain competitive advantage. However, the relationship between technological innovation, firm R&D, and firms' new product sales revenues and the mechanism of their influence still need to be further explored and researched.

In addition to technological innovation, the firm's R&D capability also has an important impact on new product sales revenue. Many scholars believe that the improvement of firms' R&D capability helps to improve the innovation and technological content of new products. Li, & Wang, (2020), after conducting an empirical study on several high-tech firms, found that the improvement of firms' R&D capability is directly related to the improvement of new product innovation capability and market competitiveness. In addition, Liu, Lei, Jiang, Hu, & Li, (2019) found in their study that the optimal allocation of firms' R&D resources can improve R&D efficiency and accelerate the process of new product development, thereby improving the quantity and

quality of firms' new product output. This, in turn, will be reflected in the firm's new product market performance.

2.6 A Literature Study on the Inverted U-Shaped Relationship between Intellectual Property Protection and Firm Innovation Outputs

The literature on the impact of intellectual property protection on firms' innovation can be divided into two categories: the first category is theoretical research literature, which draws contradictory or contrasting conclusions, while the second category is empirical research literature, which primarily supports the facilitating effect of intellectual property protection on firms' innovation and discusses the inverted U-shaped relationship intellectual property between intellectual property.

The existing relevant literature on the impact of intellectual property protection on firm innovation can be broadly categorized into two groups based on different theoretical frameworks:

The first group of research, which primarily focuses on North-South technology transfer and are based on the product cycle model, looks at how intellectual property protection in the South (developing nations) affects innovation in the North (developed countries). These texts typically make the assumptions that only developed nations create and that developing nations do not, as well as that developed nations' intellectual property laws are excellent and developing nations' laws are not, however the results are inconsistent. Part of the literature argues that stronger intellectual property protection in developing countries is detrimental to innovation in developed countries and technology transfer between North and South countries (Helpman, 1992; Glass, & Saggi, 2002); another part of the literature suggests that stronger intellectual property protection in developing countries will promote innovation in developed countries and technology transfer between North and South countries (Lai, 1998; Yang, & Maskus, 2001).

Stronger intellectual property protection in the South will deter innovation in the North when imitation is the only means of technology transfer, according to Helpman (1992), who conducted his research using the North-South product cycle model. Stronger intellectual property protection in the South, according to Hu, (2022), will increase the

share of technology licenses, lower the cost of licensing contracts, and force more resources to flow to R&D, encouraging innovation in the North and technology licensing in the South.

An empirical investigation of the inverse U-shaped link between firm innovation and intellectual property protection the theory of "optimal intellectual property protection" is still prevalent in developing countries. To test this hypothesis, several literatures have investigated the relationship between intellectual property protection and innovation.

Li, (2022) established an inverted U-shaped relationship between intellectual property protection and the creation of new products and patents using data from medium and large Chinese industrial firms from 2010 to 2019. However, the sample distribution shows that more than 95 per cent of the sample lies to the left of the inflection point, suggesting that stronger intellectual property protection generally leads to better regional innovation capabilities. Papa Georgiadis, & Sharma, (2016), using data from 48 countries from 1998 to 2011, conclude that there is generally an inverted U-shape link between intellectual property protection and innovation.

The product cycle model has had varied degrees of extended by Chinese scholars, complicating the findings. Market structure was incorporated into the product cycle model by Tang, Yu, & Chun, (2022), who discovered that in a monopolistically competitive market with some product innovation, a moderate level of intellectual property protection encourages innovation in the North. According to Liu, (2023), when the degree of skilled labor is higher in the South, reasonable intellectual property protection encourages innovation in both the North and the South in monopolistically competitive markets with horizontal innovation. Stronger intellectual property protection in the South, according to Weng, (2019), results in lower rates of innovation in both the North and the South.

Other research has discovered a potential inverted U-shaped association between corporate innovation and intellectual property protection. Stronger intellectual property protection encourages R&D but inhibits the effects of trial-and-error learning when R&D and trial-and-error learning are the two ways in which the firm innovates,

according to Furukawa, (2010), creating an inverted U-shaped relationship between intellectual property protection and firm innovation. According to Gangopadhyay, & Mondal, (2012), intellectual property protection both encourages and boosts the expected profits for innovators, but it also limits knowledge spillovers, makes innovation more difficult, and prevents corporate innovation. As a result, an inverted U-shaped link between intellectual property protection and innovation may be seen.

There has been some disagreement on the effect of intellectual property protection on business innovation at various economic development levels. The key area of contention in the literature is whether intellectual property protection encourages firm innovation in emerging nations. Strong intellectual property protection, as best demonstrated by developing countries' membership intellectual property to TRIPS, stimulates R&D investment at any level of economic development (whether in developed or developing countries), according to Guan, Yuan, & Yu, (2018) and Li, Gao, Lu, Jia, & Jing, (2020). However, when economic development is strong, the relationship between intellectual property protection and incentives for innovation is increasingly substantial.

The channels for purchasing and executing technology investments vary among areas as a result of the varying levels of economic development, according to research by Weng, (2019), Gao, Lu, Jia, & Jing, (2020) and others. Therefore, at various stages of economic development, the effect of intellectual property protection strength on firms' innovation differs. With the construction of modern industrial production systems, monopolies are preserved, and corporate innovation is promoted through increased intellectual property protection in nations or regions with higher degrees of economic development. The intellectual property protection system, however, may act as a barrier to accessing innovative technologies for regions that are at a lower stage of economic development, with emerging industries, and that are at the end of the global production chain, ultimately discouraging rather than encouraging businesses to innovate.

The findings of the above literature provide a detailed argument for the relationship between intellectual property protection and firm innovation outputs, and the inverted U-shaped relationship does exist between the two variables.

Many scholars have studied the relationship between firm innovation outputs and intellectual property protection on the basis of theoretical studies. In terms of findings, most of the literature focuses on the overall impact of intellectual property protection on firms' innovation capabilities (Table 2.3 for details). Other academic works have explored whether there is an inverted U-shaped relationship between intellectual property protection and firm innovation outputs.

Table 2.3 Advantages and disadvantages of different theories

A study of different theories	
Advantages	The ability to analyses the impact of intellectual property protection on economic growth from different perspectives provides more detailed and comprehensive results.
	For non-linear impact relationships, curve analysis provides more accurate and flexible estimates.
	For outliers and outliers, curve analysis provides more robust estimates because of its weaker assumptions about the error terms.
Disadvantages	In practice, the estimation results of curve analysis may be affected by outliers, which need to be properly dealt with.
	For non-linear influence relationships, the estimation results of curves may not be accurate enough, which requires adequate assumptions and tests on the shape of the influence relationship when using curve analysis.

2.7 Differences in the Impact of Intellectual Property Protection on Firm Innovation Outputs between State-controlled and Private Firms

The effect of intellectual property protection on firm innovation varies due to various economic development levels, subject matters, and industries. Its research primarily focuses on the various effects of intellectual property protection on firm innovation at various economic development stages and various market paretic intellectual property ants.

According to Zhao, & Cao, (2017), and Dai, (2014), intellectual property protection is positively correlated with firm innovation in developed economies but has little correlation with firm innovation in emerging economies, with the exception of

internal technology transfer. Ding, (2015) argued that, in order to avoid the use of traditional indicators of innovation (patents, value of new product output, etc.) to comprehensively describe innovation activity, literature uses a new indicator, export complexity, to measure the impact of intellectual property protection on firm innovation in a country. Based on survey data from 157 countries between 1965 and 2005, we find that intellectual property protection has a significant positive impact on firm innovation only in countries with an above-average level of economic development, while in developing countries it occasionally has a negative impact on firm innovation.

Many scholars have studied the link between the degree of financial development and innovation effectiveness from different perspectives. Fan, & Zhou, (2012) found that the degree of regional financial development and industrial agglomeration significantly affect firms' innovation ability based on panel data of high-tech industries in Chinese provinces from 1999 to 2008. Guan, & Chen, (2012), through a survey of 90 listed companies (2006–2011), find that firms' innovation efficiency increases dramatically when financing restrictions are tightened.

Different industries and business types have had their levels of innovation compared. For instance, Li, (2022) examined the innovation efficiency of high-tech businesses and discovered that there are significant variations between various business sectors and organization kinds. State ownership intellectual property has an impact on how innovative businesses are. Many scholars think that state-owned holdings have low levels of innovation efficiency. For instance, Li, (2022) examined the R&D performance of Chinese firms and discovered that state-controlled firms have the lowest R&D performance, while Dong, Zhao, & Yuan, (2014) discovered that in five Chinese high-tech industries, state-controlled firms' innovation efficiency is significantly lower than that of private firms. Ren, & Sun, (2019) measured innovation efficiency using the number of patents per capita for inventions and R&D personnel from China's inter-provincial panel data from 1998 to 2003. He discovered that innovation efficiency decreased in comparison to private firms, with the rate of loss of innovation eventually reaching more than 60%. According to Huang's (2021) research, switching from state-

controlled to non-state-controlled firms is a good approach to boost an organization's capacity for innovation.

However, other studies suggest that the innovation capacity of state-controlled firms is steadily improving. Yan & Qi (2022), based on data on Chinese industrial firms from 1998-2007 and the Ministry of Commerce's database of annual investment information on foreign-invested firms, found that foreign-invested firms and Hong Kong, Macao, and Taiwan-invested firms are more efficient than domestic firms, while state-controlled firms have lower overall efficiency but faster growth rates. According to Guan, Yuan, & Yu, (2018), from 2007 to 2011, the performance of firms' innovation was strongly and favorably correlated with the presence of state-controlled firms. They discovered, using panel data from Chinese provinces, that the presence of state-controlled companies significantly improved the performance of regional innovation.

Table 2.4 Overall impact of IPP on firm innovation outputs

Type of Research	Related Research
From the national side	Yang, L. Y., & Wang, J. (2022), using panel data for 64 developing countries, find that stronger intellectual property protection promotes innovation. Using panel data for 84 countries from 2006-2008, Tong, G. & Fan, L. F. (2022) found that stronger intellectual property protection favours technological innovation in a country, while the impact of intellectual property protection depends on the initial level of protection in each country. Guan, J. C., Zuo, K. R., Chen, K. H., & Yam, R. C. (2016) find that stronger intellectual property protection leads to more local innovation by U.S. multinationals.

Table 2.4 Overall impact of IPP on firm innovation outputs (Cont.)

Type of Research	Related Research
From the regional aspect	Yang, S. D., & Liu, Y. J. (2021), using Chinese inter-provincial panel data from 1997-2010, confirm that intellectual property rights protection positively promotes innovation output, and that intellectual property rights protection also strengthens the promotion of technological innovation by R&D inputs and import trade; Using China's inter-provincial panel data from 1997-2008, Dai, Z. Q. (2014) found that strengthening intellectual property protection can significantly promote technological innovation; Using panel data from 31 regions in China from 2001-2016, Kan, C. L. (2019), however, found that intellectual property protection can have a significant negative impact on regional innovation capacity.
From the industry side	Using industry data , Sherwood, R. M. (1997) found that strengthening intellectual property protection has a significant positive impact on technological innovation; Using data on China's manufacturing industries, Papageorgiadis, N., & Sharma, A. (2016) found that stronger industry intellectual property protection favours technological innovation; Using data on China's high-tech industries from 1995-2011, Xu, C., & Sun, Y. X. (2019) found that the promotion effect of intellectual property protection is more significant in high-technology-intensive industries, and that the smaller the technological gap in the industry, the greater the incentive effect of intellectual property protection will be.
From the firm side	Using data on all A-share main board, SME and GEM listed companies, Wu, C., Jiang, Q. Y., & Tim, Y. E. (2022) found that strengthening intellectual property protection promotes firms to enhance their innovation output and increase their R&D intensity.

Source: CNKI.

Processing by: Researcher.

2.8 Literature Related to Questionnaires

With regard to the impact of intellectual property rights on firms' innovation, a number of studies have used questionnaires to obtain data. These studies have involved firms from different regions and industries and have explored the impact of intellectual property protection on firms' perceptions of technological innovation, firms' attitudes

towards R&D, firms' attitudes towards investment in innovation, and firms' new product data.

Firstly, the increase in the level of IPP has a significant role in promoting the innovative investment of firms. For example, some studies have found, through questionnaire surveys of firms in other regions, that an increase in the level of intellectual property protection makes firms more motivated to increase their R&D investment and improve their technological level and market competitiveness (Li, R. 2022).

Secondly, intellectual property protection can promote the output of firms' innovations. Some studies have found, through questionnaire surveys of firms in other regions, that increased levels of intellectual property protection help firms to protect their innovations and reduce the risk of technological leakage, thus promoting the output of their innovations (Li, R. 2022).

In summary, the impact of intellectual property rights on firms' innovation is significant. However, it should be noted that different research methods and sample choices may lead to different conclusions. Therefore, when analysing the results of these studies, a comprehensive assessment needs to be made in the context of the specific research methodology and sample. In addition, there is a need to further explore how to formulate more effective intellectual property protection policies to promote corporate innovation and economic growth.

2.9 Review of Related Literature

Dong, Zhao, & Yuan. (2014) The conventional viewpoint primarily emphasizes the productivity loss of state-owned firms while ignoring the efficiency loss of innovation. Numerous empirical studies have demonstrated that technological innovation is the primary factor influencing a firm's efficiency, but empirical tests are uncommon. As a result, this paper conducts a systematic empirical analysis for the innovation efficiency of state-owned firms and decomposes, evaluates, and tests the innovation efficiency of state-owned firms by using data related to the technological innovation of state-owned firms and private.

Chung, C. C., Chung, M. T., Hsiao, C. C., & Yi, H. W. (2021) advanced the theoretical argument that the loss of production efficiency is greater for state-owned firms than the loss of innovation efficiency. This claim is based on the theory of firm residual claim and residual control. In order to test this hypothesis once more, this research uses data from state-owned and non-state-owned businesses at the industry level in China. The findings of the study continue to support the idea. The study also reveals that SOEs in state-owned monopoly industries have a substantially greater loss in innovation efficiency than SOEs in non-state-owned monopoly industries. The two primary objectives of SOE reform should be restructuring SOE property rights and dismantling SOE monopoly.

By distinguishing between nominal and real levels of intellectual property protection, Dai, Z. Q. (2014) successfully circumvent the measurement bias of previous literature on the degree of intellectual property protection. They experimentally assess the effects of intellectual property protection and economic development on the technological complexity of service trade exports using cross-country panel data from 66 nations. The influence of intellectual property protection on the technological complexity of services exports is found to have a U-shaped relationship for the worldwide sample. Research on affluent nations reveals a "U" relationship between intellectual property rights and the technological sophistication of services exported, but research on developing nations reveals a positive linear association.

According to Ding (2015), there is a strong deterrent effect of intellectual property protection on innovation in the South. Strict intellectual property protection causes a drop in innovation rate and a proportionate increase in the number of copycat firms in both the North and the South, whether northern manufacturers make direct investments or quality leaders have lower R&D costs. According to the studies cited in the article, various intellectual property protections ought to be used for various businesses.

Gu (2023) developed a basic framework for analyzing the interrelationship and mechanism of technological innovation between intellectual property protection system and technological innovation from the perspective of developing countries and discovered that, when intellectual property protection is strengthened, the success rate of innovation

of high-quality products will be reduced for a specific period of time; when intellectual property protection is strengthened, the wage gap between developed and developing countries will narrow; and when intellectual property protection is strengthened, the rate of innovation of low-cost products will decrease. The divide between industrialized nations, which lead in technology, and emerging nations, which have cheaper expenses, deepens; additionally, when intellectual property protection is increased, social wellbeing in developing nations with protection regimes declines.

In several Chinese provinces, Wu, Jiang, & Tim. (2022) investigated the mechanism and impact of the strength of intellectual property protection enforcement on technological innovation and firm performance. The findings indicate that the government's increased enforcement of intellectual property rights can improve businesses' capacity for innovation, as evidenced by an increase in patent production and R&D expenditures. Subsequent research also reveals that increased enforcement of intellectual property rights can foster firm innovation by minimizing the loss of R&D spillovers and easing the restrictions associated with external financing in two ways. The production of patents by businesses has a higher impact on subsequent financial performance when intellectual property protection is more strictly enforced.

Weng (2019) used cross-country panel data for 71 countries from 2006 to 2015 to investigate the effect of intellectual property protection on technology import trade. According to the findings, there is an inverse U-shaped link between the volume of technology import trade and intellectual property protection for the entire sample. It is discovered that the influence of intellectual property protection on technology trade varies between developing and developed countries for the samples of developed and developing nations. Particularly in developing countries, intellectual property protection has a favorable impact on the volume of commerce in technology imports, but not significantly in wealthy nations.

Liu (2019) With the rapid development of social economy, the role played by the legal system of intellectual property rights is growing. Intellectual property law is a product of scientific and technological progress and the development of the times, which is equivalent to an incentive promotion mechanism and was born along with the

development of knowledge economy. Intellectual property rights play a positive role in the process of technological development and innovation, and as a law that protects the intellectual products of mankind, it plays a positive role in promoting technological innovation. The core of the legal system of intellectual property is that the state protects the exclusivity of the owner of intellectual property for a certain period of time according to the law, so as to encourage creative activities. This paper briefly analyses the impact of the legal system of intellectual property on technological innovation, and provides suggestions for the legal system of intellectual property to promote technological development and technological innovation.

Feng (2020) Socialism with Chinese characteristics has entered a new era, which puts forward new requirements for the construction of the rule of law in China, including the construction of the rule of law on intellectual property. Intellectual property jurisprudence, as a category of sectoral jurisprudence, is an important theoretical weapon for promoting the construction of the rule of law of intellectual property in China. Intellectual property jurisprudence of Chinese characteristics in the new era has its own characteristics and rich content. Among them, the connotation and positioning of intellectual property jurisprudence, intellectual property policy and development, systematisation and codification of intellectual property law, rationality and pursuit of value of intellectual property legal system, effective operation of intellectual property legal system, change and development of intellectual property system, intellectual property culture, etc., are particularly important. Intellectual property jurisprudence with Chinese characteristics is a major issue in the theoretical study of intellectual property law in contemporary China and is worthy of in-depth study.

Cao (2021) At present, China's economic development is advancing rapidly, state-owned firms and state-controlled firms are the cornerstone of China's rapid economic development, and the backbone of China's economic development. The operation of state-owned and state-controlled firms largely determines the scale of China's economic market, as well as the development prospects of China's economic market in the future, which is closely related to the country's economic development and national strength development. Based on this, by analyzing the economic operation of

state-owned and state-controlled firms in the first half of 2019, combining relevant materials, discovering the characteristics of the economic development of China's state-owned and state-controlled firms, describing the unfavorable factors affecting the operation of China's state-owned and state-controlled firms, and proposing improvement measures that can enhance the development of the economic situation of state-owned and state-controlled firms.

Chen, Zheng, & Liu. (2022) demonstrate empirically how Taiwan's exports are positively impacted by the level of intellectual property protection in importing nations using the longitudinal intellectual property index created by the World Economic Forum (WEF) and controlling for endogeneity and panel unit root problems using the generalized method of moments (GMM) dynamic panel data modeling technique. This finding supports the market expansion theory that higher levels of intellectual property protection are more beneficial to trade.

Tong, & Fan. (2022) This study examines, from a dynamic standpoint, whether and how U.S. exports of information products are sensitive to nation disparities in the degree of intellectual property protection and the risk of imitation. The empirical findings support the idea that stronger intellectual property protection encourages trade by demonstrating that the degree of intellectual property protection generally exhibits a trade-promoting effect in importing nations.

According to Tang's study from 2022, moderate intellectual property protection can improve the market's environment for innovation, increase businesses' propensity to innovate, and boost the effectiveness of firm innovation. Intellectual property protection is crucial from the standpoint of corporate innovation, which is connected to technological advancement and the financial advantages of businesses. Due to the fact that intellectual property rights are exclusive, geographical, and time-bound, effective intellectual property rights protection can assist businesses in fully using the financial advantages associated with such rights, avoiding the risk of infringement, and ensuring the smooth functioning of their operations.

2.10 Brief Review of the Literature

First, through the literature of Lin (2024), Ren, Liu, Hu, & Li. (2023), Gu (2023), and Tian (2023), we understand that intellectual property protection plays an important role in promoting technological innovation of firms. A good intellectual property protection system can incentivise firms to increase their investment in technological innovation and promote the transformation of technological innovation into actual innovation output. Especially in the context of the development of digital economy and the construction of digital China, intellectual property protection provides a broader innovation space for firms and more opportunities for their technological innovation.

Secondly, from the perspective of data analysis, take the study of Li (2017) as an example, he conducted a metric analysis of the implementation level of intellectual property protection, which provides us with an objective basis for understanding the implementation of intellectual property protection. Meanwhile, from the studies of Zhou (2020) and Han, & Xu. (2021), we can learn that the increase in the level of intellectual property protection affects the choice of foreign investment, which further affects the technological innovation and innovation output of firms.

However, as mentioned earlier, intellectual property protection has an inverted U-shaped effect on firms' innovation output. This implies that, to some extent, overemphasis on intellectual property protection may dampen firms' innovative activities. In this case, policies calling for stronger intellectual property protection may need to be moderately adjusted to avoid adverse effects on firms' innovation output.

In summary, intellectual property protection is both an enabler and a constraint on the impact of firm innovation outputs. Understanding and balancing this relationship is crucial for the formulation of effective intellectual property protection policies to promote firm innovation outputs. Therefore, future research should continue to explore the complex relationship between intellectual property protection and firm innovation outputs in order to better guide practice and policymaking.

Moreover, in addition to the direct impact of intellectual property protection on firm innovation outputs, there are some indirect mechanisms of influence. For example, through technological innovation and improved R&D capability, firms are able to expand

their market share and enhance their competitiveness, thus further contributing to the growth of innovation output. This has been verified and confirmed many times in the literature, for example, Li, Gao, Lu, Jia, & Jing. (2020) show that good intellectual property protection helps firms to improve the quality and quantity of innovation output.

However, we also need to be aware that intellectual property protection may have different impacts in different countries, industries and stages of development. For example, in developing countries or emerging industries, the system of intellectual property protection may be relatively imperfect, which may limit the innovative activities of firms. On the other hand, in developed countries or high-technology industries, the system of intellectual property protection may be relatively sound, but excessive protection may also lead to knowledge monopoly and restriction of innovative activities.

Therefore, future research should pay more attention to the micro-mechanisms and industry differences of intellectual property protection on firm innovation outputs and formulate corresponding policy recommendations by taking into account the actual situation of different countries and industries. At the same time, it is also necessary to strengthen the popularization and cultivation of legal awareness of intellectual property protection, and to raise firms' awareness of the importance of intellectual property protection, so as to better protect their innovation output and promote sustainable economic development.

In summary, intellectual property protection has a complex and important impact on firm innovation outputs. Understanding the mechanism of its impact and formulating appropriate policies and measures will help to promote the sustained development of firms' innovative activities and the prosperity and progress of the economy.

However, only a small portion of the aforementioned literature particularly that on empirical evidence, has been investigated at the firm level (Guan, Yuan, & Yu, 2018). Instead, the majority of it has been studied at the national, province, and industry levels. In general, businesses make up the bulk of the economy. Studies conducted at the national, provincial, and industrial levels ignore the variability of businesses by summarizing businesses at various levels and assuming that all businesses are the same.

Large disparities between macro-level findings and micro-level findings are likely to result from differences between state-controlled and private firms.

It should be noted that although Guan, Yuan, & Yu, (2018) conducted a study at the firm level, the literature only focuses on specific subjects and uses data from listed firms, while a considerable number of firms are not listed, and the sample selection bias will make the conclusions drawn from the study using only data from listed firms insufficiently precise.

The majority of the literature now in existence on the subject of innovation efficiency begins from an empirical point of view and assesses and analyzes the innovation efficiency of various innovation subjects, industries, regions, and nations. Or, based on this, they investigate how numerous variables, such as the degree of financial development, tariffs, and marketization procedures, affect innovation efficiency. The shortfalls of the current literature include:

First, very few studies are done at the firm level; according to the researcher, Zhao, & Ding, (2013) analyzed the innovation efficiency of 151 high-technology firms in Jilin Province with DEA, but this is only a study of firms in one region, and its conclusions are only applicable to that region. Additionally, due to the obvious regional differentiation, Zhao, & Ding, (2013)'s findings are only applicable to Jilin Province.

Second, it should be noted that the existing literature pays little attention to the impact of intellectual property protection on the innovation efficiency of firms. Lin (2024) conducted a study using inter-provincial data in China from 1998 to 2008, and they found that strengthening the protection of intellectual property rights is conducive to the improvement of the efficiency of technological innovation, but the theory of intellectual property rights protection is not a concern of this literature focus.

Therefore, this paper provides an in-depth analysis of the relationship between intellectual property protection and firm innovation outputs in Sichuan Province using existing literature. Firstly, two cities, Chengdu in Sichuan Province and Zigong in Sichuan Province, were selected. Second, the impact of intellectual property protection on firms in Sichuan was assessed using data from state-controlled and private firms.

CHAPTER 3

RESEARCH METHODOLOGY

This chapter examines the research process, covering its flow, the gathering of samples and data, the creation of questionnaires, research modeling, hypotheses, and measurement. To choose the best paradigm and methodology, the researcher looked at the design of the study technique.

3.1 Research Design

In order to achieve these objectives, this study adopts a mixed method approach, combining quantitative and qualitative research. The purpose of the empirical analysis is to validate the research model proposed in this paper. For the qualitative research, in-depth interviews were conducted with state-controlled firms and private firms in Chengdu City, Sichuan Province and Zigong City, Sichuan Province. As for the quantitative research, the required data could not be obtained from objective and open sources, so they could only be collected by means of questionnaires. Questionnaires are designed according to the research topic and objectives in order to obtain accurate data that faithfully reflect the research questions (Huang, 2021; Song, Son, & Oh, 2015). The questionnaire should yield scientifically sound results.

- 1) The topic should be clear and the content of the questionnaire should be consistent with the topic of the study.
- 2) The questionnaire should avoid violating personal privacy as much as possible.
- 3) Items in the questionnaire should be clear and easy to understand to avoid ambiguity among respondents.
- 4) The arrangement should be logical and the items follow the reading and thinking patterns of the respondents. Questions can range from simple to complex.
- 5) The number of measurement items should be appropriate to avoid too many items. Consideration should be given to the time required for respondents to answer the

questions, with an estimated completion time of about 10 minutes (Huang, 2021; Song, Son, & Oh, 2015).

3.2 Research Process Flows

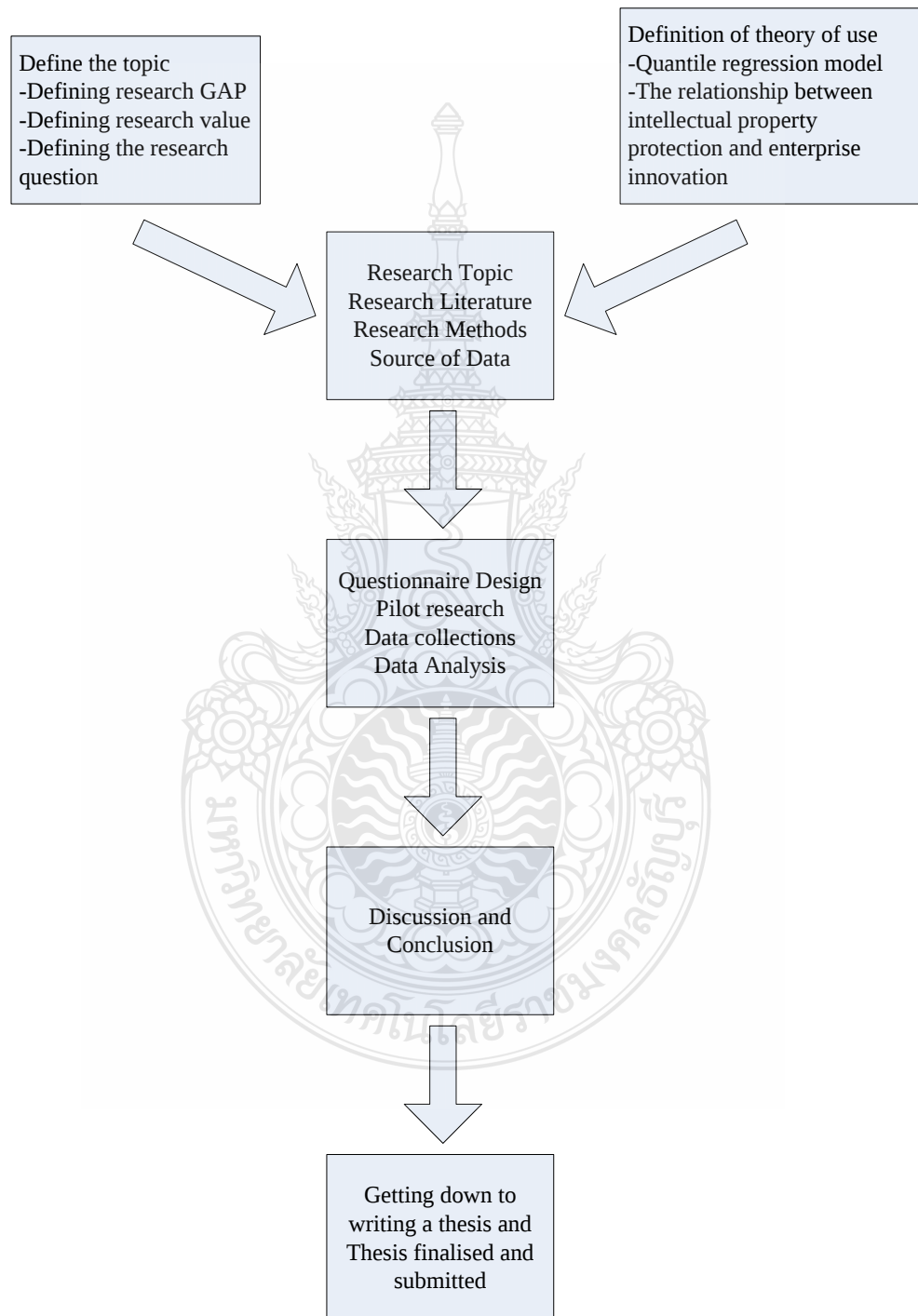


Figure 0.1 Research process

The formulation of the research question is the first step in the research process. Defining the research gap, the importance of the research, and the research challenge come before the ultimate research question. To make sure that the findings contribute to both theory and practice, the researcher must also take into account implementing theory. After choosing a study topic, the following step is to decide on the research methodology, which includes choosing a target sample and gathering data.

The project's execution phase includes questionnaire design, a pilot study, the compiling of the questionnaires, and data gathering. These are the specifics of this phase: First, the questionnaire was developed based on research and talks with experts. The researcher must run a pilot study with a limited number of target samples and trim the questionnaire to assure its completeness. The target sample was then used to collect data, after which the information was compiled. Finally, the most effective way to test the study hypothesis is through smart-PLS and SPSS data analysis.

The whole first draft of the document is defined during the finalization stage, and work is done on drafting the paper and coming to conclusions. The paper is then prepared for final editing and submission.

3.3 Population

Source of Population

The National Bureau of Statistics publishes data on businesses in Sichuan Province, and it gathers the related data by looking into the pertinent business circumstances in each of the province's regions. The information largely focuses on how market entities, state-controlled businesses, private firms, and other connected situations are doing.

The acquisition of technology and technological transformation, such as costs for the introduction of foreign technology, the digestion and absorption of imported technology, the purchase of domestic technology, and technological transformation, are also covered in other pertinent information. These government incentives include tax deductions for research and development expenses and tax exemptions for high-tech firms.

The data must be processed to make the empirical analysis easier. First, since this paper primarily examines state-controlled and private firms in Sichuan Province, we exclude the samples of non-state-controlled and non-private firms such as wholly foreign-owned firms and Chinese-foreign cooperative firms. Secondly, we exclude the samples that lack key variables like firm organization code and detailed name. Lastly, since the data year is 2020–2022, we integrate all the year samples to in order to create data, we combine the samples from all years.

To obtain the sample of effect of intellectual property protection on firm innovation in Sichuan Province, the researcher adopts the following methods:

Referring to relevant research reports: reviewing research reports on the impact of intellectual property protection on innovation of firms in Sichuan Province, which usually collect samples and analyze them.

Conducting a questionnaire survey: Design a questionnaire on the impact of intellectual property protection on innovation for state-controlled and private firms in Sichuan province, and conduct the survey online or in paper form. The questionnaire can include questions about the basic information of the firm, the status of innovation activities, and the impact of intellectual property protection on firm innovation.

Interviews with firm leaders: Select some representative firms and learn about the impact of intellectual property protection on innovation through interviews. You can ask questions about the firm's innovation strategy, intellectual property protection measures, and the relationship between technological innovation and intellectual property protection.

3.4 Sample Design and Selection

Taro Yamane's formula for calculating sample size, *Statistics: An Introductory Analysis*, Harper and Row, New York. - References - Scientific Research Publishing, states that n is the sample size, N is the population, and e is accuracy, e takes the value of 0.05, as follows:

$$n = \frac{N}{1 + Ne^2}$$

According to Table 1.1, the number of state-controlled and private firms in the two cities. The number of state-controlled firms in Chengdu is 35,000, and the number of private firms is 5,412,000. The number of state-controlled firms in Zigong is 4,400, and the number of private firms is 172,700.

Based on the above data and formulas, the calculations are as follows:

The researcher selected 395 state-controlled firms and 399 private firms in Chengdu City, Sichuan Province; and 366 state-controlled firms and 399 private firms in Zigong City. A total of 1,559 firms.

Furthermore, the researchers intend to conduct in-depth interviews with firm managers selected within the sample. These interviews are expected to offer critical empirical insights, facilitating a deeper understanding of internal operations and management practices within firms. Through direct engagement with firm managers, the researchers anticipate gaining valuable insights and experiences to further substantiate the study's conclusions and implications.

3.5 Research Instruments

The Questionnaire

Before the researcher created the questionnaire, the first draft had already been completed through similar research and consultations with professionals including academics who specialize in intellectual property protection and commercial innovation. Later, after having the initial draft, the researcher circulated some of the questionnaires to gather information for the pilot study. The researcher then debated completing the last questionnaire.

And the variables must appear in each question as shown in Table 3.1 to Table 3.4.

3.6 Statistics and Data Analysis Methods

Based on the availability of data, this study chooses state-controlled and private firms in Chengdu and Zigong, Sichuan Province, as its samples. Find the data sources that are available, such as government agencies, business associations, commercial databases, research reports, etc. Analyze the data's accuracy, dependability, and coverage.

Based on the study's objectives and the quantity of data at hand, choose the right sample size.

For this investigation, a questionnaire will be employed. Respondents rate their agreement with the description of the question item's content on a five-point Likert scale between 1 and 5, with higher scores indicating greater agreement.

The questionnaire for this paper contains questions that are all drawn from mature scales of their own, but from the standpoint of scientific rigor and rigor, it is still necessary to conduct a pre-test through the analysis of the questionnaire's content and structure in order to test and fix any problems with the questionnaire and ensure a high-quality questionnaire.

The questionnaire's content validity must first be evaluated. We intend to invite five experts three university professors and five corporate managers who have experience managing intellectual property protection in businesses to this content validity test to evaluate the questionnaire in terms of conceptual crossover and overlap, consistency of representation of measurement questions and variables, and other factors so that it can be revised and improved.

After that, the questionnaire's structural validity and reliability were examined. Both offline and online valid questionnaires were gathered from a sample of randomly chosen Chinese businesses. Exploratory factor analysis and reliability analysis were used to analyze the sample data. In order to incorporate the opinions of the respondents, the formal questionnaire was lastly amended.

A combination of the Questionnaire Star online survey and the on-site field survey, where questionnaires were handed out and gathered, were used to conduct the data sampling for the study. The data was analyzed using SPSS and SmartPLS.

First, the basic situation of the firm and the situation of the decision makers were described using descriptive expressions. Next, the validity of the scales used in the questionnaire and the data collected were assessed. Finally, structural equation modeling was used to examine the impact of corporate factors and decision maker trait factors on intellectual property management for company business development.

The Cronbach's alpha reliability coefficient, which is now popular in academia, was utilized in this study to analyze questionnaire reliability. According to general consensus, when $> .8$, it indicates a very high level of consistency of the individual scale question items; when is $.6- .8$, it indicates a relatively good reliability of the questionnaire items; and when $.6$, the reliability situation of the questionnaire items is poor. Therefore, for the questionnaire to be considered reliable, must be at least more than $.5$.

3.7 IPP and Firm Innovation

3.7.1 Intellectual Property Protection and Internal Firm Innovation

Table 3.1 Intellectual property protection and internal firm innovation

Variable Name	Questions
IPP1	Firms understand and are aware of the level of IPP.
IPP2	Firms know the type of intellectual property.
IPP3	Firms see IPP as important for internal innovation.
IPP4	IPP is conducive to promoting technological progress and R&D.
IPP5	IPP encourages firms to innovate more.

3.7.2 Technological Innovation in Internal Firms

Table 3.2 Technological innovation

Variable Name	Questions
TI1	The place of technological innovation in the firm.
TI2	The firm has set up a specialised R&D team.
TI3	The method of technological innovation used by the firm. (e.g., independent research and development; technology introduction, etc.)
TI4	Challenges in technological innovation in the host firm.
TI5	The impact of technological innovation on business.

3.7.3 Firm Research and Development (R&D) Capability

Table 3.3 Firm innovation: R&D capability

Variable Name	Questions
R&DC1	The impact of R&D on firm innovation.
R&DC2	R&D position of the firm.
R&DC3	The firm has set up a specialised R&D team.
R&DC4	The firm invests in research and development.
R&DC5	The major areas of the firm's research and development.
R&DC6	Challenges for firms in R&D. (e.g., insufficient funding; legal and intellectual property issues, etc.)
R&DC7	R&D has had a positive impact on the firm.

3.7.4 Firm Innovation Outputs

Table 3.4 Firm innovation outputs

Variable Name	Questions
FIO1	Income from new product sales meets expectations.
FIO2	Good feedback from the market for new products.
FIO3	New products are accurately targeted at the target customer.
FIO4	New products are in line with market trends within the industry.
FIO5	Compared with competitors, our new products have more competitive advantages.

3.8 Content Validity and Reliability Analysis

3.8.1 Content Validity

The main objective of pre-testing is to identify potential weaknesses and flaws in the design of the questionnaire to ensure that the questionnaire captures the full range of information required. Pre-testing with three to five representative respondents is usually sufficient to identify potential problems in the questionnaire. Such pre-testing is intended to improve the quality of the questionnaire to ensure that it is effective in meeting

the objectives of the study and that accurate and meaningful feedback is obtained from the respondents.

Firstly, the design of the questionnaire for this study was based on relevant literature and the views of experts in the field of research and was carefully reviewed by three research professionals in the field of firm management and corporate finance. These professionals were asked to provide a comprehensive review of the questionnaire, not only commenting on the content aspects, but also providing additional insights as to whether the questionnaire topics were difficult to understand or contained ambiguities. In addition, the experts were specifically invited to comment on specific item sections of the questionnaire measurements, including a wide range of aspects such as scale items, question content, question wording and order, form layout, length, timing, continuity and flow. In the pre-testing phase, the questionnaire covered all aspects in detail to ensure that it was comprehensive, clear and well organized. Based on the feedback from the experts, the questionnaire was revised to further optimize the questions and measures of the research instrument.

Secondly, based on the participants' feedback and suggestions, the researcher revised the questionnaire to improve its accuracy and validity.

Finally, the questionnaire was tested again for validation. Content validity was assessed by five professionals, aligned by three university professors and two professionals from the business sector. IOC was used to assess the consistency between the test items and the objectives.

Table 3.5 Significance of IOC Scores

IOC value	Meaning
+1	The question is consistent with the objective
-1	The question is inconsistent with the objective
0	Uncertain, its needs some revision.

$$IOC = \frac{\sum R}{N}$$

R=Expert's assessment score

N= Number of subject-matter experts

In the above equation, R=expert score value; N=number of experts. Questionnaire questions with scores below 0.5 are modified. Questionnaire questions with scores between 0.5 and 1.0 are feasible.

Table 3.6 Results of content validity tests

Items	Source	Measurement Scale Adopted	Items	IOC
Intellectual Property Protection: 9 projects in three main categories (Legislative level; Level of law enforcement; Level of economic development)	Liu, (2019)	5-point scale ranging from “strongly disagree” to “strongly agree”	9	1
Technological Innovation; R&D Capability: 9 projects in two main categories	Yang, (2021)	5-point scale ranging from “strongly disagree” to “strongly agree”	9	1
Firm Innovation Outputs: 5 projects in one category (market performance of new products)	Weng, (2019)	5-point scale ranging from “strongly disagree” to “strongly agree”	5	1

Table 3.6 shows the measurement scales and item sources used in the study are shown. Intellectual property protection, technological innovation and R&D capability, and firm innovation outputs were all measured on a 5-point scale ranging from "strongly disagree" to "strongly agree". The sources of these items include different academic studies presented by Liu, (2019), Yang, (2021), and Weng, (2019), respectively. Intellectual property protection involves three main categories, namely the level of legislation, the level of enforcement and the level of economic development, with a total of nine projects. Technological innovation and R&D capacity involve two main categories with nine items. In contrast, firm innovation output involves only one category, new product market performance, with five items. The choice of these item sources and measurement scales ensured rigor and credibility and provided the basis for the reliability of the study.

Table 3.7 IOC expert scores

Variable	Item	Subject-matter expert					Average	Total Average
		1	2	3	4	5		
IPP	LEL1	0	+1	+1	+1	+1	.800	.956
	LEL2	+1	+1	+1	+1	+1	1.000	
	LEL3	+1	+1	+1	0	+1	.800	
	LLE1	+1	+1	+1	+1	+1	1.000	
	LLE2	+1	+1	+1	+1	+1	1.000	
	LLE3	+1	+1	+1	+1	+1	1.000	
	LED1	+1	+1	+1	+1	+1	1.000	
	LED2	+1	+1	+1	+1	+1	1.000	
	LED3	+1	+1	+1	+1	+1	1.000	
TI	TI1	+1	+1	0	+1	+1	.800	.960
	TI2	+1	+1	+1	+1	+1	1.000	
	TI3	+1	+1	+1	+1	+1	1.000	
	TI4	+1	+1	+1	+1	+1	1.000	
	TI5	+1	+1	+1	+1	+1	1.000	
R&DC	R&DC1	+1	+1	+1	+1	+1	1.000	.920
	R&DC2	+1	0	+1	+1	+1	.800	
	R&DC3	+1	+1	+1	+1	0	.800	
	R&DC4	+1	+1	+1	+1	+1	1.000	
FIO	FIO1	+1	+1	+1	+1	+1	1.000	.960

Table 3.7 IOC expert scores (Cont.)

Variable	Item	Subject-matter expert					Average	Total Average
		1	2	3	4	5		
	FIO2	+1	+1	+1	+1	+1	1.000	
	FIO3	+1	+1	+1	+1	+1	1.000	
	FIO4	+1	+1	+1	+1	+1	1.000	
	FIO5	+1	+1	+1	0	+1	.800	

Table 3.7 shows the evaluation scores from the content validity test as assessed by the Index of Convergence (IOC), where an IOC of 1 indicates that the questions are consistent with the objectives. The results of the expert assessment of the IOC of the questionnaire show that all questions were scored, indicating that the questionnaire was accepted in all areas.

3.8.2 Reliability Analysis

Many of the instruments and scales used in this study were adapted from past research, and initially the instruments were pretested for reliability and validity by the previous researcher. However, the new research setting may have caused these instruments to perform differently. When using multi-item scales for survey instruments, it is particularly important to validate the internal reliability of the measure. Currently, Cronbach's alpha is the most widely used method for confirming the internal consistency of all factors. It is generally accepted that when the score is greater than .8, it indicates a high degree of consistency across the items within the scale; when the score is .6- .8, it indicates good reliability of the questionnaire items; and when the score is less than .6, the questionnaire items have a poor reliability profile. Therefore, the score must be at least greater than .5 to be reliable.

Table 3.8 Measurement validation results

Items	Cronbach's alpha
Intellectual Property Protection	.780
Technological Innovation & R&D Capability	.888
Firm Innovation Outputs	.878

Table 3.8 shows a pilot study of questionnaire prediction from 10 randomly selected firms. To assess the reliability of Cronbach's alpha. As shown in the above table, the Cronbach's alpha coefficient is greater than .750. therefore, the questionnaire in the study has reliability for further analysis.

3.9 Hypotheses

The study's hypothesis and through-trail analysis are shown in Figure 3.2. This is due to the requirement that SmartPLS and SPSS for H1, and SmartPLS for H2&H3.

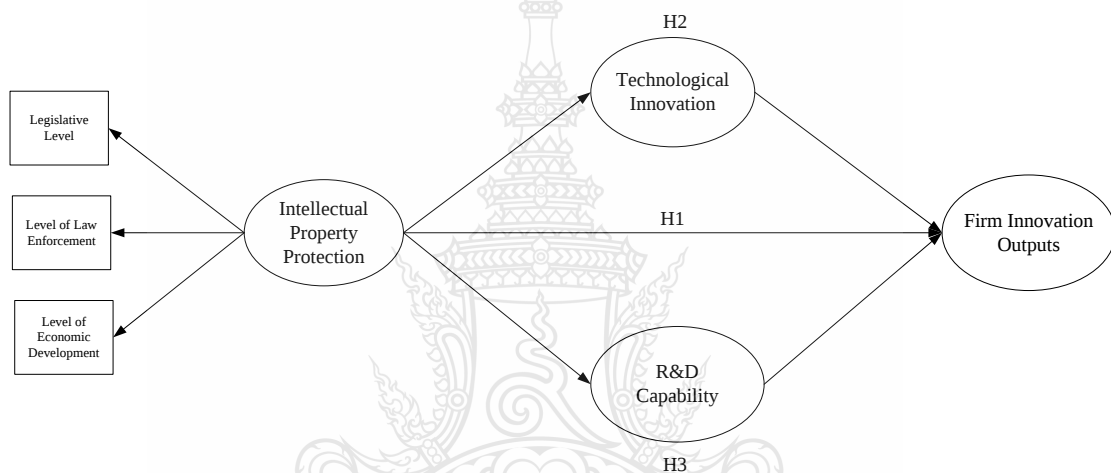


Figure 0.2 Assumptions and access analyses of the researches

3.9.1 Intellectual Property Protection and Technological Innovation & R&D Capability

Strengthening intellectual property protection is effective for firms' technological innovation and R&D capability, according to the direct impact condition. The degree of intellectual property protection, including judicial protection, administrative protection and other preliminary constraints on behaviors, affects the effectiveness and level of firms' technological innovation and R&D capability. A more effective intellectual property protection system enhances the intangible economic benefits of the economy by creating a legal and institutional environment for innovation, making protection more stringent, protecting the benefits derived from the creative achievements of firms, reducing or avoiding "free-rider" behaviors, and substantively safeguarding the R&D benefits of firms.

This can substantially improve the innovation ability of firms and safeguard R&D advantages, which is conducive to the development of the market economy (Ji, & Zhang, 2023). On the contrary, if the protection of intellectual property rights is too weak, it will promote "free-riding" behaviors, weaken the innovation drive of firms, or even lead to innovation stagnation, which is not conducive to economic growth.

Therefore, the researcher proposes the following hypotheses:

H1: Intellectual property protection and firm innovation outputs are related and have an inverted U-shaped relationship.

3.9.2 Intellectual Property Protection Affects Firm Innovation Outputs through Technological Innovation

In Cao's (2021) investigation, technological innovation emerges as a pivotal mediating mechanism in delineating the intricate relationship between intellectual property protection and firm innovation outputs. Positioned not merely as an outcome but as a prime impetus of intellectual property protection, technological innovation assumes multifaceted roles within this paradigm.

Firstly, the establishment of a robust intellectual property protection framework incentivizes firms to augment their investments in technological innovation endeavors. Such incentivization stems from firms' proclivity towards sustained research and development initiatives under the auspices of intellectual property protection, aimed at securing technological advantages and safeguarding innovative outcomes.

Secondly, the catalyzing effect of technological innovation extends to bolstering firms' competitive edge and market positioning, thereby amplifying their exigency for and cognizance of intellectual property protection. Concurrently, ongoing technological innovation endeavors empower firms to continually refine and enrich their Intellectual Property portfolios, thereby fortifying their foothold within the market landscape (Ji, 2023).

Consequently, technological innovation serves as a pivotal intermediary within the nexus of intellectual property protection and firm innovation outputs, whereby bolstering the implementation and enforcement of intellectual property protection mechanisms invariably fosters firms' technological innovation initiatives, thereby elevating the echelons of innovation outputs.

Therefore, the researcher proposes the following hypothesis:

H2: Technological innovation mediates the relationship between intellectual property protection and firm innovation outputs.

3.9.3 Intellectual Property Protection Affects Firms' Innovation Output through R&D Capability

In the investigation conducted by Sheng, Wu, Sheng, Wang, & Shi, (2023), R&D capability emerges as a pivotal mediating conduit within the intricate interplay between intellectual property protection and firm innovation outputs. Positioned as the cornerstone for firms' pursuit of technological innovation and inventive endeavors, R&D capability assumes a dual role as both an object and an outcome of intellectual property protection. Firstly, the establishment of a robust intellectual property protection framework catalyzes firms' motivation and investment in innovation endeavors.

Firms exhibit a heightened propensity to channel resources into R&D activities under the premise of robust intellectual property rights enforcement, perceiving it as a strategic imperative to fortify their innovative pursuits. Secondly, the augmentation of R&D capability amplifies firms' exigency for and awareness of intellectual property protection. Through sustained R&D endeavors, firms not only enhance their innovation prowess but also fortify their capacity to safeguard and leverage their intellectual property assets, thereby augmenting their competitive stance within the market milieu. Concurrently, effective intellectual property protection furnishes firms with a conducive milieu for innovation and market stability, thereby engendering a virtuous cycle of heightened R&D activities and innovation impetus.

Consequently, R&D capacity assumes a pivotal intermediary role between intellectual property protection and firm innovation outputs, whereby bolstering the implementation and enforcement of intellectual property protection mechanisms serves to galvanize firms' R&D pursuits and innovation outputs, ultimately fostering sustainable economic development.

Therefore, the researcher proposes the following hypothesis:

H3: R&D Capability mediates the relationship between intellectual property protection and firm innovation outputs.

CHAPTER 4

RESEARCH RESULT

4.1 Introduction

This chapter presents the results of the study that are consistent with the objectives and hypotheses of the study. The chapter consists of ten sections. Following this introduction, the data preparation strategy is outlined in section 4.2, demographic data is conducted in section 4.3, and then descriptive statistics are performed in section 4.4. Next, a normal distribution test of the data was conducted in section 4.5, followed by exploration factor analysis for each construct in 4.6, confirmatory factor analysis in section 4.7, correlation analysis in section 4.8, hypothesis 1 was tested using SPSS curvilinear regression in Section 4.9, and hypotheses 2 and 3 were tested using smartPLS in Sections 4.11 to 4.13, 4.14 qualitative analysis.

4.2 Data Preparation

This section deals directly with data arrangement, including data screening, editing and data coding and entry. A detailed description is given below.

4.2.1 Screening of Data

In order to obtain complete data, the researcher conducted the following data collection process. The target groups, state-controlled firms and private firms in Chengdu City, Sichuan Province and state-controlled firms and private firms in Zigong City, Sichuan Province were contacted. Questionnaires were sent out to 395 state-controlled firms and 399 private firms in Chengdu City, Sichuan Province and 366 state-controlled firms and 399 private firms in Zigong City selected by the researcher, a total of 1,559 questionnaires.

The researcher received 505 returned questionnaires, excluding invalid questionnaires, and finally collected 150 questionnaires from state-controlled firms and 200 questionnaires from private firms in Chengdu City, Sichuan Province and 52 questionnaires from state-controlled firms and 100 questionnaires from private firms in Zigong City, Sichuan Province, for a total of 502 questionnaires.

4.2.2 Construction of Relevant Variables

We coded the variables in this study, thus simplifying the process of processing and interpreting the data. The variables were abbreviated as shown in Table 4.1.

Table 4.1 Abbreviations for variables

Construct Group	Observed Variable	Type of Variable
Intellectual Property Protection (IPP)	Legislative Level (LEL)	Independent Variable
	Level of Law Enforcement (LLE)	
	Level of Economic Development (LED)	
Firm Innovation Outputs (FIO)	Technological Innovation (TI)	Mediating Variable
	R&D Capability (R&DC)	
		Dependent Variable

4.3 Demographic Data

The respondents of the questionnaire sent to the research sample were the management of state-controlled and private firms in Chengdu, Sichuan Province and state-controlled and private firms in Zigong, Sichuan Province. The questions were about demographics and included five sections: ownership, region, education, experience and size. A summary of the demographics is shown in Table 4.2.

Table 4.2 Summary of demographics

	Frequency	Percentage
Ownership		
State-controlled firm.	200	39.84
Private firm.	302	60.16
Area		
Chengdu	350	69.72
Zigong	152	30.28
Educational		
Bachelor's Degree	179	35.66
Master's Degree	161	32.07

Table 4.2 Summary of demographics (Cont.)

	Frequency	Percentage
Doctoral Degree	162	32.27
Year of experience		
Less than 5 years	134	26.69
5-10 years	127	25.30
10-15 years	116	23.11
15years and over	125	24.90
Employees		
Less than 50	32	6.37
50-200	201	40.04
More than 200	269	53.59

The questionnaire profile consists of educational background, firm ownership, firm size, work experience, and perception of the level of intellectual property rights in the region where the firm is located.

The personal profile of the respondents, in terms of educational background, was largest for respondents with bachelor's degree levels at 35.66%, Master's Degree level at 32.07%, and Doctoral graduates at 32.27%. As for the ownership of the firm, 39.84% were state-controlled and 60.16% were private. Regarding work experience, 26.69% had less than five years, 25.30% had 5-10 years, 23.11% had 10-15 years, and 24.90% had 15 years or more. Regarding the size of the company (measured by the number of full-time employees), 6.37% of the companies with more than 200 employees were the largest group, followed by the group with 50 to 200 employees at 40.04%, and the smallest group with fewer than 50 or less employees at 6.37%. These results indicate that the largest group of firms surveyed are large firms. In terms of the experience of the firms, the experience of firms with less than 5 years is 26.69%, the percentage of 5 to 10 years is 25.30%, almost the same percentage of firms with more than 15 years of experience is at 24.90% and the percentage of firms with 10 to 15 years of experience is 23.11%.

In terms of the level of intellectual property protection for the region, the level of Intellectual Property awareness of firm managers in Chengdu City is higher than the level of intellectual property awareness of firm managers in Zigong City. State-controlled firms in Chengdu City invested 23.6% of their firms' innovation investment in intellectual property protection, while state-controlled firms in Zigong City invested only 9.2% of their firms' innovation investment in intellectual property protection, concentrating on the cost of handling infringement cases in their firms. Private firms in Chengdu City invested 13% of their firms' innovation investment in intellectual property protection, while private firms in Zigong City invested only 3.9%. Private firms in Chengdu may show a more positive attitude towards intellectual property protection. Comparatively, private firms in Zigong may need more education and support to raise awareness of intellectual property protection.

4.4 Descriptive Statistics

This section summarizes the characteristics of the data collected for this study and is presented in a quantitative and comparable manner.

4.4.1 Intellectual Property Protection

The attributes of the level of intellectual property protection are measured by three observational variables: knowledge of intellectual property law, the level of legislative level, awareness of intellectual property, the level of law enforcement, and the level of economic development of the region to which the incentive to innovate responds. These independent variables are used to assess the level of respondents' agreement. Table 4.3 presents statistical analyses of means and standard deviations.

Table 4.3 Descriptive statistics on the level of intellectual property protection

Variable	Mean	SD
Legislative Level		
LEL1	3.544	1.341
LEL2	3.627	1.334
LEL3	3.584	1.325
Level of Law Enforcement		
LLE4	3.620	1.354
LLE5	3.590	1.371
LLE6	3.691	1.319
Level of Economic Development		
LED7	3.543	1.306
LED8	3.594	1.384
LED9	3.633	1.353

At the level of intellectual property legislation, the item with the highest means is "Firms know the type of intellectual property." (M=3.691, SD=1.319). At the regional level of economic development, the item with the lowest means "The level of economic development in the location of the firm is good." (M=3.543, SD=1.306).

In addition, the study also utilized Min-Max values and addressed missing values to inspect possible errors that might affect the accuracy of the data. In this context, the Min-Max values fall within the range of 1 to 5, and the missing value is 0, indicating that there are no unanswered responses. Consequently, the data can be considered for further analysis.

4.4.2 Technological Innovation

Technological innovation mediates between intellectual property protection and firm innovation outputs. The statistical analyses of mean and standard deviation values are shown in Table 4.4.

Table 4.4 Descriptive statistics on technological innovation

Variable	Mean	SD
Technological Innovation		
TI10	3.910	1.242
TI11	3.930	1.264
TI12	3.948	1.193
TI13	3.843	1.251
TI14	3.880	1.282

The item with the highest means in technological innovation is "The firm has a sound strategy for embracing technological innovation. " (M=3.948, SD=1.193). In technological innovation, the item with the lowest means is "Your firm that believes technological innovation is important to its success." (M=3.843, SD=1.251).

In addition, the study also utilized Min-Max values and addressed missing values to inspect possible errors that might affect the accuracy of the data. In this context, the Min-Max values fall within the range of 1 to 5, and the missing value is 0, indicating that there are no unanswered responses. Consequently, the data can be considered for further analysis.

4.4.3 R&D Capability

R&D capability mediates intellectual property protection and firm innovation outputs. The statistical analyses of mean and standard deviation are presented in Table 4.5.

Table 4.5 Descriptive statistics on R&D capability

Variable	Mean	SD
R&D Capability		
R&DC15	3.809	1.302
R&DC16	3.809	1.304
R&DC17	3.815	1.265
R&DC18	3.800	1.300

The item with the highest means in R&D capability is "The firm has established a top-notch R&D staff." (M=3.815, SD=1.265). The item with the lowest means in R&D capability is "R&D has had a beneficial effect on the firm." (M=3.800, SD=1.300).

In addition, the study also utilized Min-Max values and addressed missing values to inspect possible errors that might affect the accuracy of the data. In this context, the Min-Max values fall within the range of 1 to 5, and the missing value is 0, indicating that there are no unanswered responses. Consequently, the data can be considered for further analysis.

4.4.4 Firm Innovation Outputs

The attributes of firm innovation outputs are measured by the observed variable of market performance of new products. The mean and standard deviation were statistically analyzed as shown in Table 4.6.

Table 4.6 Descriptive statistics on firm innovation outputs

Variable	Mean	SD
Firm Innovation Outputs		
FIO19	4.071	1.242
FIO20	4.008	1.284
FIO21	3.988	1.265
FIO22	4.026	1.222
FIO23	4.008	1.240

Firm innovation outputs, the item with the highest means "Income from new product sales meets expectations." (M=4.071, SD=1.242) and the item with the lowest means "New products are accurately targeted at the target customer." (M=3.988, SD=1.265).

In addition, the study also utilized Min-Max values and addressed missing values to inspect possible errors that might affect the accuracy of the data. In this context, the Min-Max values fall within the range of 1 to 5, and the missing value is 0, indicating that there are no unanswered responses. Consequently, the data can be considered for further analysis.

4.5 Results of Measurement Model Analysis

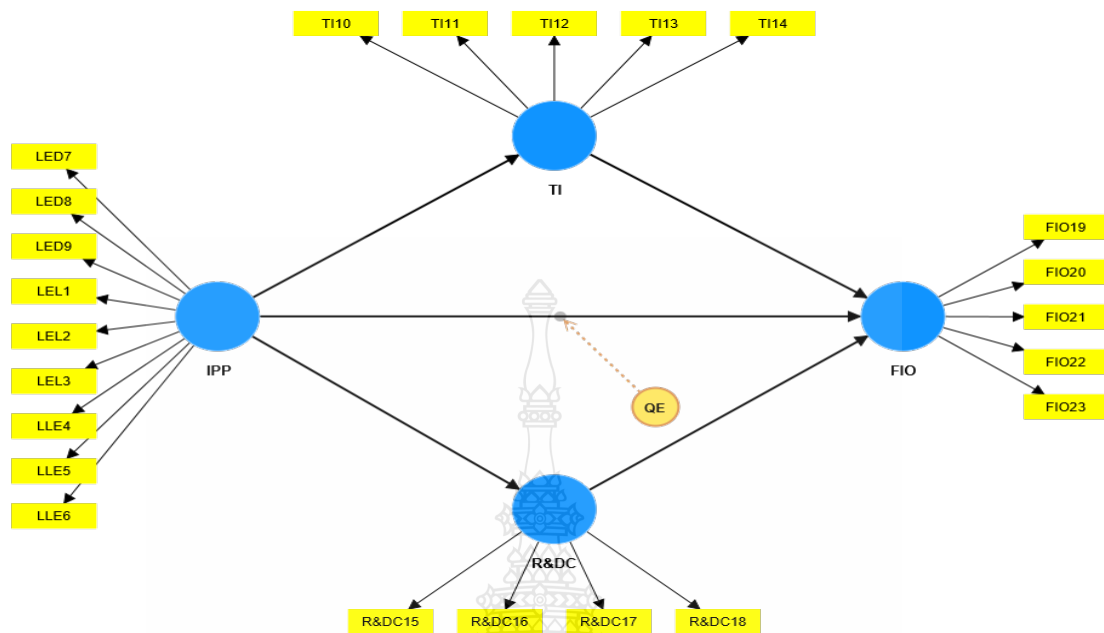


Figure 4.1 Shows the measurement model diagram

4.5.1 Testing Criteria

The study employed the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach using the pre-built software SmartPLS 4. The relationships between latent variables and observed variables were modeled as reflective. The statistical criteria for the measurement model are presented in Table 4.7.

Table 4.7 The test criteria for both the Measurement model and Structural Equation Modeling in SEM testing

Measurement	Measurement index	Criterion
Measurement model		
Construct Reliability	Cronbach Alpha(α)	> .7 (Joe F. Hair et al., 2011)
	Jöreskog's rho (ρ_c)	> .7 (Henseler et al., 2016)
	Dijkstra-Henseler's rho (ρ_A)	> .7 (Henseler et al., 2016)
	Composite Reliability	> .7 (Barclay et al., 1995; Joe F. Hair et al., 2011)
	Indicator Reliability	.70 (Chin, 1998)

Table 4.7 The test criteria for both the measurement model and structural equation modeling in SEM testing (Cont.)

Measurement	Measurement index	Criterion
Convergent Validity	Average Variance Extracted (AVE)	> .5 (Fornell & Bookstein, 1982; Joe F. Hair et al., 2011)
Discriminant Validity	Heterotrait-Monotrait Ratio of Correlations (HTMT)	AVE > r (Fornell & Bookstein, 1982)
Structural Equation Modeling		
Coefficient of Determination R^2	The ability to explain variance	Chin (1998) defines 0.19 as small, .33 as medium, and .67 as large. F. Hair Jr et al. (2014) defines .25 as small, .50 as medium, and .75 as large.
Predictive Relevance, Q^2	Stone-Geiser Test	>0 (Geiser, 1974; Stone, 1974)
Path Coefficient	The path coefficient or the direct effect value in path analysis	Effect size, tools, and p-values. (F. Hair Jr et al., 2014; Selya et al., 2012)

The utilization of the SmartPLS program (Dijkstra & Henseler, 2015) for data processing yields distinct results when compared to other programs, particularly regarding reliability assessment by Dijkstra-Henseler's ρ_A and Jöreskog's ρ_C , both of which should have a value of .7 or higher (Henseler et al., 2016). It is also recommended that Composite Reliability be calculated using the Sum Score, not the Construct Score, particularly not the Cronbach Alpha. The results obtained lead to the conclusion that the reliability value should be considered as a lower boundary in discriminant validity. The Heterotrait-Monotrait Ratio of Correlations (HTMT) by Henseler et al. (2016) is advised, with a value greater than one and statistically significant (Henseler et al., 2016), which is not available in other programs. Additionally, to evaluate the model fit and validity of the model (Saturated Model), the SRMR (Standard Root Mean Square Residual) should be calculated, with $SRMR < 95\%$ Bootstrap Quantile (HI95 of SRMR), dG (Geodesic Discrepancy) with $dG < 95\%$ Bootstrap Quantile (HI95

of dG), and dULS (Unweighted Least Square Discrepancy) with dULS < 95% Bootstrap Quantile (HI95 of dULS).

The quality of structural equation models is assessed based on loadings, ρ values, R^2 . Hair et al. (2011) proposed three levels of R^2 for social science research: .25 for weak, .50 for moderate, and .75 for significant. Henseler (2016) and Hair (2021) stated that Q^2 values greater than 0 indicate that the model has predictive relevance, and Q^2 values significantly greater than 0 (e.g., greater than .25) may indicate that the model has strong predictive power.

4.5.2 Structural Reliability of the Model

Table 4.8 Average variance extracted and composite reliability analysis results for models

Variables	Items	AVE	CR
Intellectual property protection (IPP)	9	.647	.933
Technological Innovation (TI)	5	.639	.862
R&D Capability (R&DC)	4	.702	.860
Firm Innovation Outputs (FIO)	5	.727	.906
QE(IPP) (IPP ²)			1.000

Note: AVE=Average Variance Extracted, CR=Composite Reliability, QE=Quadratic Effect.

As shown in Table 4.8, the Average Variance Extracted (AVE) values ranged from .639 to .727 and the Composite Reliability (CR) values ranged from .860 to 1.000, which generally indicates that an AVE greater than .5 or a CR greater than .7 indicates a high degree of convergent validity, indicating the existence of a moderate to strong direct relationship, which indicates good convergent validity of the data in this study. In summary, all variables show good reliability and validity, which means that they can be effectively used for further analyses and research. In particular, Intellectual Property Protection (IPP) showed significant importance in terms of both reliability and Quadratic Effect (QE), that is, the square of IPP (IPP²), which may be of practical significance in exploring the complex relationship between FIO and IPP.

Table 4.9 Confidence and validity coefficients of the model

Items	α	ρ_a	ρ_c	AVE
IPP	.932	.933	.943	.647
TI	.859	.862	.899	.639
R&DC	.859	.860	.904	.702
FIO	.906	.906	.930	.727
QE(IPP) (IPP ²)		1.000		

Note: IPP=Intellectual Property Protection, TI=Technological Innovation, R&DC=R&D Capability, α =Cronbach's Alpha, ρ_a =Composite reliability (rho_c), ρ_c =Composite reliability (rho_c), AVE=Average Variance Extracted, QE=Quadratic Effect.

In social science research, reliability coefficients are important measures of the consistency and stability of a questionnaire or measurement instrument. Cronbach's alpha (α), composite reliability (ρ_a), and composite reliability (ρ_c) are commonly used reliability coefficients. Cronbach's alpha (α) is used to measure the internal consistency of a set of items as a whole. A Cronbach's alpha (α) value of .7 or greater is generally considered to indicate good internal consistency, values between .6 and .7 are acceptable, but values below .6 are generally considered to indicate poor consistency. Composite reliability (ρ_c) is used to assess the composite reliability of a model, and generally a value of ρ_c greater than .7 is considered good for composite reliability. In structural equation modeling (SEM) analysis, Average Variance Extracted (AVE) is a key measure of the convergent validity of the reflective construct. It reflects the average variance of the construct metrics compared to the amount of error variance associated with that construct. In general, the AVE value should be greater than or equal to .5.

Cronbach's alpha (α) for intellectual property protection (IPP) has an α of .932, indicating a high degree of consistency in the measurement tools. Similarly, technological innovation (TI) has an α of .859, R&D capability (R&DC) has an α of .859, and firm innovation outputs (FIO) has an α of .906, all of which indicate a high degree of consistency of the measurement instrument in the measurement of the corresponding latent variables. Composite reliability (ρ_a & ρ_c) is another measure of internal consistency, similar to Cronbach's alpha but more flexible. In Table 4.9, the values of ρ_a and ρ_c are very close to Cronbach's alpha, ranging between .860 and .943, respectively,

further confirming the internal consistency of the measurement instrument. Average Variance Extracted (AVE) is an indicator used to assess the convergent validity of the latent variable, indicating the variance explained by the variance of the latent variable's constituent terms as proportion. In Table 4.9, the AVE values for all the latent variables ranged from .639 to .727, indicating that the corresponding constituent terms explain the latent variables they represent well. This statistical information provides an important basis for assessing the quality of the measurement model and provides a reliable foundation for further research.

4.5.3 Outer Loadings

The core function of Outer Loadings is to measure the extent to which variables explain latent factors (Hair, 2009). Theoretically, a value greater than or equal to .7 indicates that the variable is highly related to the latent factor it represents; between .5 and .7 is considered acceptable; less than .5 suggests a weak relationship, necessitating reevaluation or removal.

Table 4.10 Outer loadings

Indicator	FIO	IPP	R&DC	TI	QE (IPP) (IPP ²)
FIO19	.845				
FIO20	.847				
FIO21	.831				
FIO22	.894				
FIO23	.845				
LED7		.811			
LED8		.803			
LED9		.791			
LEL1		.801			
LEL2		.813			
LEL3		.803			
LLE4		.821			
LLE5		.806			
LLE6		.788			
R&DC15			.833		
R&DC16			.841		

Table 4.10 Outer loadings (Cont.)

Indicator	FIO	IPP	R&DC	TI	QE (IPP) (IPP²)
R&DC17			.840		
R&DC18			.840		
TI10				.786	
TI11				.802	
TI12				.790	
TI13				.824	
TI14				.796	
QE (IPP) (IPP ²)					1.000

Table 4.10 shows that the loading coefficients of the variable firm innovation output (FIO) are between .831 and .894, which are greater than the cross-loadings with the other variables. This indicates that the model has good discriminant validity. The loading factors for the variable Intellectual Property Protection (IPP) ranged between .788 and .821, both of which were greater than the cross loadings with the other variables. This indicates that the model has good discriminant validity. The loading factors for the variable research and development capability (R&DC) ranged between .833 and .841, both of which were greater than the cross-loadings with the other variables. This indicates that the model has good discriminant validity. The loading factors for the variable Technological Innovation (TI) ranged between .786 and .824, both of which were greater than the cross loadings with the other variables. This indicates that the model has good discriminant validity. QE(IPP) (quadratic effect of intellectual property protection, IPP²) as a separate factor has a loading of 1.000, which is usually the result of the model setup, indicating that the secondary effect is fully captured.

In summary, Table 4.10 demonstrates a well-structured payload matrix in which each indicator is strongly correlated with its corresponding factor and the relationship with other factors is minimized. This structure helps ensure measurement accuracy and model simplicity and is an important step in validated factor analysis.

4.5.4 Discriminant Validity: Fornell-Larcker Criterion

Table 4.11 Discriminant validity: Fornell-Larcker criterion

Indicator	FIO	IPP	R&DC	TI
FIO	.853			
IPP	.497	.804		
R&DC	.503	.517	.838	
TI	.515	.552	.478	.800

Note: Squared correlations; AVE in the diagonal.

Table 4.11 shows the correlation coefficients and squared correlation coefficients between the four latent variables. The values on the diagonal represent the average variance extracted (AVE) for each latent variable and the values on the off-diagonal represent the correlation coefficients between the latent variables. Firstly, we note the values on the diagonal, which are the average variance extracted for FIO (firm innovation output), IPP (intellectual property protection), R&DC (research and development capability), and TI (technological innovation). These values indicate the variance explaining power of each construct for its measure. For example, the AVE for Firm Innovation Output (FIO) is .853 ($.853^2 = .728$ approximates its proportion of variance explained), the AVE for Intellectual Property Protection (IPP) is .804, the AVE for R&D Capability (R&DC) is .838, and the AVE for Technological Innovation (TI) is .800.

Second, the values on the non-diagonal line indicate the squared correlation coefficient between the different constructs. For example, the squared correlation coefficient between FIO and IPP is 0.497, which means that the correlation coefficient between FIO and IPP is approximately $\sqrt{0.497} \approx 0.705$ (Square Root Calculations), indicating a moderately strong positive correlation between the two.

According to the Fornell-Larcker criterion, in order to establish good discriminant validity, the square root of the AVE of each construct (i.e., the open square

of the value on the diagonal) should be greater than its correlation coefficient with the other constructs. Let's verify this:

The square root of the AVE for FIO is $\sqrt{0.853} \approx 0.924$ (Square Root Calculations), which is larger than the correlation coefficient of FIO with any other construct (e.g., about 0.705 with IPP).

The square root of IPP's AVE is $\sqrt{0.804} \approx 0.897$ (Square Root Calculations), which is also greater than its correlation coefficient with the other constructs.

Similarly, we can verify that R&DC and TI fulfil this condition.

Thus, according to the Fornell-Larcker criterion, the data in the table indicate that the four constructs have good discriminant validity, they can be effectively differentiated from each other. This is an important validity testing step when conducting structural equation modelling (SEM) analysis.

4.5.5 Discriminant Validity - Heterotrait-Monotrait Ratio of Correlations (HTMT) Criterion

Table 4.12 Heterotrait-Monotrait ratio of correlations (HTMT)

Indicator	FIO	IPP	R&DC	TI	QE (IPP) (IPP ²)
FIO					
IPP	.536				
R&DC	.569	.574			
TI	.583	.612	.556		
QE (IPP)(IPP ²)	.571	.850	.563	.635	

The heteroskedasticity-homoscedasticity correlation ratio (HTMT) is a method for assessing discriminant validity in variance-based structural equation modelling (e.g., PLS-SEM). When the HTMT value is less than 1, it indicates that the construct is more strongly correlated with its own metrics than with other constructs, thus confirming discriminant validity (Dirglatmo, 2023). The HTMT criterion is recommended for its reliability in detecting a lack of discriminant validity in common research scenarios as

opposed to older methods such as the Fornell-Larcker criterion (Ab Hamid, Sami, & Mohmad Sidek, 2017). In Table 4.14, the values on the non-diagonal lines represent the correlation coefficients between the different latent variables, while the blanks on the diagonal lines indicate the correlation coefficients of each latent variable with itself, as the correlation coefficient of itself is always 1. By looking at the values on the non-diagonal lines, we can see the correlation between the latent variables.

The HTMT correlation of FIO metrics with IPP is .536. This indicates that there is some correlation between FIO metrics and the IPP dimension. The HTMT correlation of FIO metrics with R&DC is .569, which is slightly higher than the correlation of FIO with IPP. The HTMT correlation of FIO metrics with TI is .583, which is the highest correlation between FIO and the other dimensions. This may indicate a relatively stronger relationship between FIO and TI. The HTMT correlation of FIO with QE(IPP) is .571, which is higher than the direct correlation of FIO with IPP. The HTMT correlation of QE(IPP) with IPP is .850, which is the highest correlation presented in the table. Since QE(IPP) (IPP²) is a secondary effect of IPP, this high correlation is expected and indicates a strong link between the secondary effect and its underlying dimension.

4.5.6 Discriminant Validity-Cross Loading Criterion

To determine discriminant validity using cross loading, it is necessary to check whether the cross-loading of each indicator on its own construct is significantly higher than its cross-loading on all other constructs. This helps to assess discriminant validity, i.e. whether the different constructions are statistically clearly distinguishable, which indicates that each indicator corresponds well to the construction to which it belongs and that there is good discriminant validity between the constructions. If the cross-loading value of an indicator on a construct other than its own is close to or exceeds the cross-loading value on its own construction, this may indicate a problem with discriminant validity, and the relationship between the indicators and the constructs needs to be investigated further.

Table 4.13 Cross-loading values for the model

Indicator	FIO	IPP	R&DC	TI	QE (IPP) (IPP ²)
FIO19	.845	.434	.455	.440	-.458
FIO20	.847	.430	.405	.440	-.478
FIO21	.831	.442	.407	.441	-.469
FIO22	.894	.382	.441	.429	-.443
FIO23	.845	.428	.433	.445	-.469
LED7	.483	.811	.474	.495	-.651
LED8	.343	.803	.420	.388	-.651
LED9	.341	.791	.360	.420	-.670
LEL1	.421	.801	.415	.450	-.641
LEL2	.362	.813	.409	.444	-.666
LEL3	.418	.803	.407	.477	-.658
LLE4	.411	.821	.410	.427	-.674
LLE5	.373	.806	.418	.438	-.657
LLE6	.419	.788	.415	.440	-.669
R&DC15	.425	.393	.833	.393	-.396
R&DC16	.403	.424	.841	.385	-.462
R&DC17	.416	.458	.840	.429	-.425
R&DC18	.440	.455	.840	.394	-.466
TI10	.388	.396	.363	.786	-.427
TI11	.427	.423	.406	.802	-.448
TI12	.424	.416	.366	.790	-.463
TI13	.423	.519	.386	.824	-.527
TI14	.396	.443	.389	.796	-.490
QE (IPP) (IPP ²)	-.544	-.820	-.522	-.591	1.000

As shown in Table 4.13, for the Discriminant validity measure of the model, the indicators of IPP (LEL, LLE and LED) have significantly higher cross loadings on IPP than on R&D capability (R&DC) and technological innovation (TI), and similarly R&D capability (R&DC) has significantly higher cross loadings than technological innovation (TI), QE (IPP) (IPP²) is fully correlated with itself, this is because it is a separate measure, with a loadings of 1.000.) cross loadings are also significantly higher than those on

Technological Innovation (TI), and QE (IPP)(IPP²) is fully correlated with itself with a loading of 1.000, this is because it is a separate factor or variable that is naturally fully correlated with itself. This indicates that each indicator has a good correspondence with the construction to which it belongs and that there is good discriminator validity between the constructions. In addition, we can see that indicator such as FIO, LED, and LEL have negative loadings on QE (IPP)(IPP²), which indicates that these indicators have some negative correlation with QE (IPP)(IPP²).

4.5.7 Model fit and Validity

To assess the fit and validity of the model, a number of key statistical measures must be calculated, including Standardized Root Mean Square Residual (SRMR), Geodesic Discrepancy (d_G Geodesic Discrepancy), and Unweighted Least Squares Discrepancy (d_ULS Unweighted Least Squares Discrepancy). SRMR is a measure of model residuals; ideally, the SRMR value should be less than .08, indicating that the model is a good fit to the data. d_G is a model fit metric based on geodesic distance that measures the difference between the inferred model covariance matrix and the data covariance matrix. d_ULS is another metric for evaluating model fit, and similar to d_G, it compares the difference in the covariance matrix between the model and the data.

Table 4.14 SRMR, d_G and d_ULS values of the model

Indicator	Saturated model	Estimated model
SRMR	.048	.060
d_ULS	.529	.004
d_G	.180	.185

In Table 4.14, SRMR (Standardised Root Mean Square Residual) is a measure of the difference between the data observed in the model and the model predictions. A lower SRMR value indicates a better fit of the model to the data. The Saturated model has an SRMR value of .048 while the Estimated model has an SRMR value of .060. SRMR is a measure of the fit of the model, with lower values indicating a better fit of the model. Typically, an SRMR value of less than .08 is considered a good fit. Although the

SRMR value of the estimated model is slightly higher than that of the saturated model, both are within an acceptable range.

In Table 4.14, the Saturated model has a d_ULS value of .529, while the Estimated model has a significantly lower d_ULS value of .004. d_ULS is a measure of how well the model differs from the data. A lower d_ULS value indicates a better fit of the model to the data. Here, the estimated model significantly outperforms the saturated model on the d_ULS metric, indicating a good fit of the model to the data.

In Table 4.14, the Saturated model (Saturated model) has a d_G value of .180, while the Estimated model (Estimated model) has a d_G value of .185. Similar to d_ULS, d_G is a measure of model-data variance, but it is based on generalised least squares. In this example, the d_G values of the two models are not very different and both are at relatively low levels, indicating that both models perform well on the generalised least squares index of variation.

In summary, Table 4.14 provides three different indicators of the quality of model fit. SRMR indicates that the fit of both models is within an acceptable range, while d_ULS and d_G provide information on the extent to which the models differ from the data. In particular, the significant improvement in d_ULS indicates that the estimated models performed well in fitting the data.

4.5.8 Path Coefficients

The path coefficient is an important concept in structural equation modelling (SEM) that measures the strength of the relationship between latent variables or between latent and observed variables. It reflects the degree of influence of the independent variable on the dependent variable and is usually expressed as a standardised regression coefficient. The path coefficient usually ranges from -1 to 1, with positive values indicating a positive correlation and negative values indicating a negative correlation, with larger values indicating a stronger relationship. The significance test of the path coefficient can be used to determine whether the path coefficient is significantly non-zero, thus determining whether a relationship exists between the variables. The interpretation of path coefficients needs to be combined with theory and practice, and the results can be used to explain and predict the relationship between variables.

Table 4.15 Path coefficients values of the model

Indicator	Original sample (O)	Sample means (M)	95%CI		95%BCCI	
			Lower	Upper	Lower	Upper
IPP -> FIO	.043	.040	-.068	.143	-.065	.146
IPP -> R&DC	.517	.518	.426	.604	.420	.598
IPP -> TI	.552	.553	.468	.634	.463	.629
R&DC -> FIO	.242	.243	.129	.355	.126	.352
TI -> FIO	.230	.233	.120	.351	.118	.348
QE (IPP)(IPP ²) -> FIO	-.210	-.209	-.310	-.102	-.310	-.101

Table 4.15 shows the original sample values (O), sample means (M), and 95% confidence intervals (CI) and 95% bias-corrected and accelerated confidence intervals (BCCI) for the path coefficients. Path coefficients are estimated from structural equation modelling (SEM) and represent the direct effect of the independent variable on the dependent variable. 95% confidence intervals provide an estimate interval for the path coefficients and can be used to assess the accuracy and stability of the estimates. Bias-corrected and accelerated confidence intervals (BCCI) are a modification to the 95% confidence intervals and can provide more accurate estimates of the confidence intervals for the path coefficients, especially when the sample is small or skewed. This information helps to assess the statistical significance and stability of the path coefficients, thereby improving the explanatory and predictive power of structural equation models.

1) The path coefficient for IPP -> FIO is .043 (original sample), implying that IPP has a positive but weak effect on FIO. Its 95% confidence interval and 95% bias-corrected confidence interval both contain 0, indicating that this effect is statistically insignificant.

2) The path coefficient of IPP -> R&DC is .517, indicating that IPP has a strong positive effect on R&DC and that this effect is statistically significant because neither its 95% confidence interval nor its 95% deviation-corrected confidence interval contains zero.

3) The path coefficient for IPP $\rightarrow$ TI is .552, showing that IPP also has a significant positive effect on TI. Again, its confidence interval does not contain 0, confirming the significance of this effect.

4) The path coefficient for R&DC $\rightarrow$ FIO is .242, indicating that R&DC has a positive effect on FIO and that this effect is statistically significant.

5) The path coefficient of TI $\rightarrow$ FIO is .230, indicating that TI also has a positive and significant effect on FIO.

6) The path coefficient of QE (IPP)(IPP²) $\rightarrow$ FIO is -0.210, implying that QE (IPP)(IPP²) has a negative effect on FIO and this effect is statistically significant.

4.5.9 Explanatory Power of the Model, Predictive Power and Actual Impact of Each Pathway

1) R², the coefficient of determination, is an important indicator of the model's fit. It reflects the extent to which the independent variables in the model explain the changes in the dependent variable, and the value of R² usually lies between 0 and 1. The closer the value is to 1, the greater the extent to which the independent variables explain the changes in the dependent variable, and the better the model fits. Specific criteria usually depend on the field of study and the specific situation, but in general the following apply R² < .3: the model is usually considered poorly fitted, with the independent variable explaining less of the variation in the dependent variable. $.3 \leq R^2 < .5$: indicates that the model has a moderate level of explanatory power. R² $\geq .5$: implies that the model is well fitted, with the independent variable explaining more of the variation in the dependent variable.

It is important to note that R² is not the only measure of a good model. An excessively high R² may mean that the model is overfitted, while an excessively low R² may indicate that the model lacks sufficient explanatory power. In addition, R² adjusted (R² adjusted) is also an important indicator, which takes into account the number of independent variables in the model on the basis of R², and can more accurately reflect the model's fitting effect.

Table 4.16 Model's Coefficient of Determination (R^2) and its Adjusted Coefficient of Determination (R^2 adjusted)

Variable Name	Items	O	M	STDEV	O/STDEV	p
FIO	R^2	.396	.402	.051	7.734	.000
	R^2 adjusted	.391	.398	.052	7.578	.000
TI	R^2	.305	.308	.046	6.642	.000
	R^2 adjusted	.304	.307	.046	6.599	.000
R&DC	R^2	.267	.271	.046	5.807	.000
	R^2 adjusted	.266	.269	.046	5.764	.000

Note: O=Original sample, M=Sample mean, ST=Standard deviation (STDEV), $|O/ST|=T$ statistics ($|O/STDEV|$), $p=p$ values.

As shown in Table 4.16, for the FIO variable, the R^2 of the model is .396 (original sample), implying that the model explains about 39.6 per cent of the variation in the data. The adjusted R^2 is .391, which is slightly lower than the R^2 , but still indicates that the model has good explanatory power.

For the TI variable, the R^2 and adjusted R^2 are .305 and .304, respectively, indicating that the model explains about 30.5 per cent of the variation in the data, which is a lower percentage than FIO but still has some explanatory power.

For the R&DC variable, the R^2 and adjusted R^2 were .267 and .266, respectively, indicating that the model explained about 26.7 per cent of the variance in the data, which was the lowest explanatory power of the three variables.

2) Q^2 is a measure of predictive relevance used to assess the predictive power of reflective constructs in structural equation modeling. It is calculated using a blindfold procedure. If the value of Q^2 is greater than 0, it means that the model has predictive validity for the data. When interpreting Q^2 , it is generally accepted that a Q^2 value close to 0 but greater than 0 indicates that the model has minimal predictive power, a Q^2 value significantly greater than 0 (e.g., greater than 0.25) indicates that the model has moderate predictive power, and a Q^2 value much greater than 0 (e.g., greater than 0.50) indicates that the model has strong predictive power.

Q^2 is an important complementary metric when analyzing models, especially when you need to test the predictive power of a model rather than just its goodness of fit, and Q^2 helps to assess the validity of a model in real-world applications.

Table 4.17 Q^2 Value of the model

Items	FIO	TI	R&DC
Q^2	.256	.191	.185

As shown in Table 4.17, for FIO the Q^2 value is .256, indicating that the variable contributes to the prediction of the model to a greater extent. For TI the Q^2 value is .191 which indicates that the variable contributes to the prediction of the model to some extent. For R&DC the Q^2 value is .185 which shows that this variable also contributes to the prediction of the model to some extent.

Typically, a Q^2 value greater than 0.25 is considered to have some predictive capability, while a value exceeding 0.50 indicates strong predictive ability. These values suggest significant variations in the predictive power of the model across different subgroups. In any scenario, a Q^2 value above 0 implies that the model possesses at least minimal predictive relevance across all sample populations.

4.6 Hypothesis Testing Results

4.6.1 Measurement Model Diagram

Table 4.18 Outer model collinearity statistics (VIF)

Variable	VIF	Variable	VIF	Variable	VIF
FIO19	2.280	LEL1	2.231	R&DC17	1.968
FIO20	2.434	LEL2	2.400	R&DC18	1.945
FIO21	2.192	LEL3	2.267	TI10	1.850
FIO22	3.233	LLE4	2.462	TI11	1.882
FIO23	2.343	LLE5	2.312	TI12	1.811
LED7	2.273	LLE6	2.129	TI13	1.944
LED8	2.337	R&DC15	1.985	TI14	1.828
LED9	2.247	R&DC16	2.044	QE (IPP)	1.000

Table 4.19 Inner model collinearity statistics (VIF)

Construct	FIO	IPP	R&DC	TI	QE (IPP) (IPP ²)
FIO					
IPP	3.192		1.000	1.000	
R&DC	1.498				
TI	1.654				
QE (IPP) (IPP ²)	3.390				

From Table 4.18, and Table 4.19 it can be observed that the VIF (Variance Inflation Factor) for all variables is less than 5, indicating the absence of multicollinearity.

4.6.3 Path Analysis

Path model coefficients (β) were evaluated, which represent the hypothesized relationships between and among the constructs and range from -1 to 1 (Hair Jr et al., 2021). Critical values for two-tailed t values at a 90% significance level are 1.645, 95% significance level is 1.96 and at a 99% significance level, 2.57 (Hair et al., 2019). In Structural Equation Modeling (SEM), a p-value of ≤ 0.05 is considered to indicate statistical significance, a p-value of ≤ 0.01 denotes a high level of statistical significance, and a p-value of ≤ 0.001 represents an extremely high level of statistical significance (J. Cohen, 2013; Fisher, 1970). Path model coefficients (β), two-tailed t values and the corresponding p values are displayed in Table 4.20.

Table 4.20 Direct effects path model coefficients (N=502)

Inner Path Model	β	t	P
IPP -> FIO	.043	.799	.424
IPP -> R&DC	.517	11.583	.000
IPP -> TI	.552	13.239	.000
R&DC -> FIO	.242	4.181	.000
TI -> FIO	.230	3.923	.000
QE (IPP)(IPP ²) -> FIO	-.210	3.916	.000

Table 4.20 demonstrates the direct effect coefficients for the path model. Direct effects refer to the direct effect of one variable on another variable without going through any mediating variables.

1. Inner Path Model: This column shows the different paths in the model, i.e. which variable directly affects which variable.

IPP -> FIO: indicates the direct impact of IPP on FIO.

IPP -> R&DC: Indicates the direct impact of IPP on R&DC; IPP -> TI: Indicates the direct impact of IPP on R&DC.

IPP -> TI: indicates the direct effect of IPP on TI.

R&DC -> FIO: indicates the direct influence of R&DC on FIO.

TI -> FIO: indicates the direct influence of TI on FIO.

2. β : This is the standardised value of the path coefficient, which indicates the extent to which the independent variable has a direct effect on the dependent variable.

The value of β for IPP -> FIO is .043, indicating that for every one unit increase in standard deviation of IPP, FIO only increases by .043 units of standard deviation on average. This value indicates that the direct effect of IPP on FIO does not hold;

The β values for IPP -> R&DC and IPP -> TI are .517 and .552, respectively, and these values are relatively large, indicating that IPP has a significant direct effect on R&DC and TI;

The β values for R&DC -> FIO and TI -> FIO are .242 and .230, respectively, indicating that R&DC and TI have a moderate direct effect on FIO.

The β value for QE (IPP) (IPP²)-> FIO is -.210, indicating that some quality factors associated with QE and IPP has a negative direct effect on FIO.

3. t: The t-value is a statistic used to test whether a path coefficient is significant. A large t-value usually means that the path coefficient is significantly non-zero.

The t-value for IPP -> FIO is .799, which is much smaller in absolute value than the critical value that would normally be considered significant (for larger sample sizes, such as N=502 here, the critical value would normally be closer to 2), and therefore the beta for that path is not significant.

The t-values for IPP -> R&DC and IPP -> TI are 11.583 and 13.239, respectively, both of which are very large, well above the critical value at any reasonable level of significance, and thus the beta values for these paths are highly significant.

The t-values for R&DC -> FIO and TI -> FIO are 4.181 and 3.923, respectively, and these values also exceed the critical values that would normally be considered significant, suggesting that the β -values for these paths are significant.

The t-value for QE (IPP)(IPP²) -> FIO is -3.916 (the negative sign indicates the direction), the absolute value of which also exceeds the critical value, indicating that the β -value for this path is significant.

4. p: The p-value is used to determine the significance of the path coefficient. If the p-value is less than some level of significance (e.g., .05), the hypothesis that the path coefficient is 0 is rejected as significant.

For example, the p-value for IPP -> FIO is .424, which is much greater than .05, so this path coefficient is not significant, implying that the direct effect of IPP on FIO may be weak or nonexistent.

In contrast, the p-values for the other paths are all much less than .05, indicating that the coefficients for these paths are significant.

In summary, this table shows the direct effects between the variables and their significance in the path model. It is worth noting that the direct effect of IPP on FIO is not significant, but it has a significant indirect effect on FIO through R&DC and TI (as shown in Table 4.20). This suggests that IPP may affect FIO mainly through mediating variables in this model.

4.6.4 Mediation Analysis.

Specific indirect effects, which evaluate the β constructs through at least one additional mediating construct and estimate the relevance of significant relationships (Hair et al., 2019), were analyzed using SmartPLS software and is shown in Table 4.21.

Table 4.21 Path model specific indirect effects (N=502)

Path	Specific Indirect Effects β	<i>t</i>	<i>p</i>
IPP -> TI -> FIO	.127	3.358	.001
IPP -> R&DC -> FIO	.125	3.533	.000

Table 4.21 illustrates specific indirect effects in a path model. In path analyses, an indirect effect is the effect of one variable (the independent variable) on another (the dependent variable) through one or more intermediate variables.

1. Path: This is the path that describes how the independent variable (IPP) affects the dependent variable (FIO) through an intermediate variable (TI or R&DC).

IPP -> TI -> FIO: indicates that it affects FIO indirectly from IPP;

IPP -> R&DC -> FIO: indicates indirect influence on FIO from IPP through R&DC.

2. Specific Indirect Effects β : This is the standardized coefficient (β -value) for specific indirect effects. This value indicates the magnitude of the effect of the intermediate variable on the dependent variable and has taken into account the effects of the other variables.

IPP -> TI -> FIO has a β value of .127, which means that IPP has a positive indirect effect on FIO through TI, and the size of this effect is about .127 units;.

IPP -> R&DC -> FIO has a beta value of .125, which also indicates that IPP has a positive indirect effect on FIO through R&DC, and the size of this effect is about .125 units.

3. t-value: The t-value is a statistic used to test the significance of a particular indirect effect. When the absolute value of the t-value is greater than a certain threshold

(usually calculated based on the sample size and a set level of significance), we can consider the indirect effect to be significant.

The t-value of IPP → TI → FIO is 3.358, which is a relatively large value indicating that the indirect effect is significant.

The t-value for IPP → R&DC → FIO is 3.533, which is also a relatively large value and also indicates that the indirect effect is significant.

4. p-value: The p-value is used to assess the probability of rejection of a statistical hypothesis (in this case, the assumption that the indirect effect is zero). If the p-value is less than a set level of significance (usually 0.05 or 0.01), we reject the original hypothesis and consider the indirect effect to be non-zero.

The p-value of 0.001 for IPP → TI → FIO is much smaller than the commonly used significance level, so we can consider this indirect effect significant.

The p-value for IPP → R&DC → FIO is 0.000 (note that 0.000 here may be an approximation and may actually be a very small non-zero number), again much smaller than the commonly used significance level, so this indirect effect is also significant.

In summary, this table tells us that IPP has a significant positive indirect effect on FIO through both TI and R&DC intermediate variables in the path model under study.

4.6.5 Hypothesized Relationships

The results of the hypothesized relationships of the research model are presented in this section. The hypotheses, associated predictor paths, path coefficient (β), significance (t value and associated p values) and the result of the hypotheses are shown in Table 4.22.

Table 4.22 Hypotheses results (N=502)

Label	Predictor	β	t	p	Result
H1	QE (IPP)(IPP ²) → FIO	-.210	3.916	0.000	Supported
H2	IPP → TI → FIO	0.127	3.358	0.001	Supported
H3	IPP → R&DC → FIO	0.125	3.533	0.000	Supported

From the results of the hypothesis test given in Table 4.22,

H1: Intellectual property protection and firm innovation outputs are related and have an inverted U-shaped relationship.

Result: The result of this hypothesis is 'Supported'. β is -.210, t-value is 3.916, and p-value is 0.000, which suggests that there is a negative correlation between Intellectual Property Protection (QE (IPP)(IPP²)) and firms' Innovation Output (FIO). To verify the inverted U-shaped relationship, it is usually necessary to include the quadratic term QE (IPP)(IPP²) in the model.

H2: Technological innovation mediates the relationship between intellectual property protection and firm innovation outputs.

Result: The result of this hypothesis is 'Supported'. From the given data, the β value is .127, t value is 3.358 and p value is 0.001, which indicates that technological innovation (TI) acts as a mediator variable and plays some role between intellectual property protection (IPP) and firms' innovation output (FIO).

H3: R&D capacity mediates the relationship between intellectual property protection and firm innovation outputs.

Result: The result of this hypothesis is also 'Supported'. β -value is .125, t-value is 3.533, and p-value is 0.000, which indicates that R&D capability (R&DC), as another mediating variable, also plays a role in the relationship between Intellectual Property Protection (IPP) and firms' Innovation Output (FIO). role.

To summarise, Table 4.22 provides the results of testing the three hypotheses, where H1, H2 and H3 are all supported. However, it is important to note that the inverted U-shaped relationship referred to in H1 is directly reflected and requires further model validation. H2 and H3 show the mediating role of technological innovation and R&D capabilities between IPP and firms' innovation output.

4.6.6 Further Model Validation of Hypothesis 1

In SPSS software, curvilinear regression analysis was used to verify the inverted U-shaped relationship of the impact of intellectual property protection on firm innovation outputs. The specific results are as follows:

Table 4.23 Results of the model summary

R	R²	Adjusted R²	Std. Error of the Estimate
.564	.318	.315	.882

From the summarized results of the model given in Table 4.23, it appears that

1.R:

An R value of .564 indicates the strength of the linear relationship between the independent variables (IPP and other potential independent variables) and the dependent variable (firms' innovation output). Specifically, this means that the independent variables in the model explain about 56.4 per cent of the variance in the dependent variable. The closer the R value is to 1, the stronger the independent variables are in explaining the dependent variable.

2. R²:

The R² value is .318, which is the square of the R value and also indicates the percentage of the variation in the dependent variable explained by the model. In Table 4.25, the model explains 31.8% of the variation in the dependent variable. The closer the value of R² is to 1, the better the fit of the model.

3. Adjusted R²:

An Adjusted R² value of .315 takes into account the number of independent variables in the model and gives a more accurate measure of model fit. Adjusted R² is usually slightly smaller than R², especially if there are multiple independent variables in the model. In this example, Adjusted R² is similar to R², suggesting that the number of independent variables in the model may be relatively small, or that each independent variable has a relatively large effect on the dependent variable.

4. Std. Error of the Estimate:

The Std. Error of the Estimate value is .882, which indicates the error range of the model's predictions. Specifically, for each predicted value in the model, there is approximately a 68.2% probability that the true value will fall within the predicted value plus or minus one standard error (i.e., predicted value $\pm$.882). A smaller standard error means that the model's predictions are more accurate.

In summary, the model explains about 31.8 per cent of the variance in the dependent variable (firm innovation output) and the model is relatively well fitted (given that Adjusted R^2 is similar to R^2).

Table 4.24 Results of ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	180.965	2	90.482	116.275	<.001
Residual	388.308	499	.778		
Total	569.273	501			

From the ANOVA (Analysis of Variance) results given in Table 4.24, it can be analyzed as follows:

1. Sum of Squares:

Regression: 180.965. This is the portion of variation in the model due to the explanation of the dependent variable by the independent variable.

Residual: 388.308. This is the portion of variation in the model that is not explained by the independent variable, the error variance.

Total: 569.273. This is the total variation in the dependent variable, which is equal to the sum of the regression sum of squares and the residual sum of squares.

2. df:

Regression: 2, which indicates that there are two independent variables in the model (or two degrees of freedom used to explain variation in the dependent variable).

Residual: 499, the residual degrees of freedom are equal to the total number of observations minus the number of parameters in the model (including the intercept).

Total: 501, Total degrees of freedom is the number of observations minus one.

3. Mean Square:

Regression: 90.482, which is obtained by dividing the regression sum of squares by the regression degrees of freedom.

Residual: .778, which is obtained by dividing the residual sum of squares by the residual degrees of freedom.

4. F:

The value of F is 116.275 which is the ratio of regression mean square to residual mean square. F statistics are used to test the significance of the effect of the independent variable on the dependent variable in the model.

5. Sig:

A Sig. value less than .001 means that the effect of the independent variable on the dependent variable in the model is extremely statistically significant. This means that we can reject the null hypothesis that there is a significant relationship between independent and dependent variables.

To summarise, the ANOVA results indicate that the independent variables in the model have a significant effect on the dependent variable (Sig. < .001) and that this effect is well beyond the range of the random error (F=116.275). This supports the fact that our model is statistically valid and that the independent variables do contribute significantly to predicting the dependent variable.

Table 4.25 Coefficient of correlation

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
intellectual property protection	2.160	.283	2.215	7.633	<.001
intellectual property protection ** 2	-.267	.045	-1.709	-5.889	<.001
(Constant)	.030	.393		.076	.939

From the table of correlation coefficients given in Table 4.25, it can be analysed as follows:

This table shows the coefficient estimates, standard errors, standardised coefficients (Beta), t-values and significance levels (Sig.) for two predictor variables (one primary and the other quadratic) and a constant term (intercept) in the regression model.

1. Unstandardized Coefficients:

B: This is the estimate of the regression coefficients. the coefficient of intellectual property protection is 2.160, which means that for every unit increase in intellectual property protection, the dependent variable will increase by an average of 2.160 units, holding other variables constant (assuming this is the linear The coefficient for intellectual property protection ** 2 is 2.160) The coefficient for intellectual property protection ** 2 is -.267, which means that for every unit increase in the square of intellectual property protection, the dependent variable will decrease by .267 units on average (this is the non-linear part of the model).

Std. Error: this is the standard error of the regression coefficients and is used to estimate the precision of the coefficients and for statistical tests.

2. Standardized Coefficients:

Beta: this is the standardized regression coefficient which indicates the magnitude of the effect of the predictor variable on the dependent variable after excluding differences in the scale. The value of Beta is independent of the units of the predictor and dependent variables and allows comparison of the relative importance of different predictor variables on the dependent variable.

3. t:

This is the t-statistic which is used to test whether the coefficient of each predictor variable is significantly not equal to zero.

4. sig. (level of significance):

This is the significance level of the t-test. Sig. values for both intellectual property protection and intellectual property protection ** 2 are less than .001, indicating that the coefficients of these two predictor variables are statistically extremely significant, i.e., they have a significant effect on the dependent variable.

5. Constant:

This is the intercept term of the regression equation, which is the expected value of the dependent variable when all predictor variables are zero. In this example, the intercepting term is .030, but its t-value and Sig. value indicate that this intercept term is not significant (Sig. = .939), which may be due to the fact that the observations in the

sample are not exactly distributed around the origin of the dependent variable.

To summarize, this regression model includes a primary term and a secondary term on intellectual property protection and both terms have a significant effect on the dependent variable. The nonlinear part of the model (the secondary term) shows an inverted U-shaped relationship.

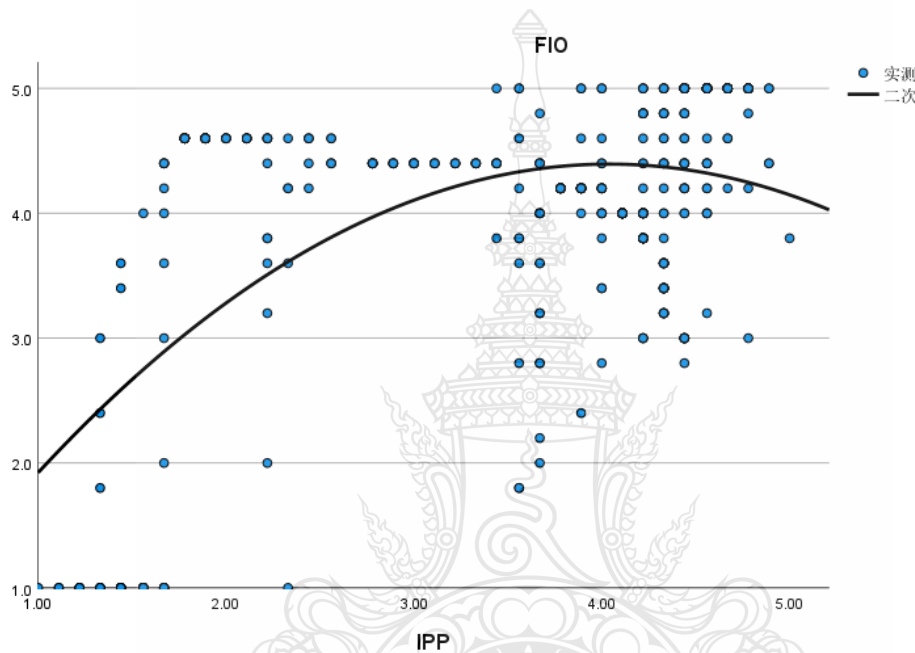


Figure 4.3 Curvilinear regression plot of the relationship between intellectual property protection and firm innovation outputs

4.7 Summary of Data Analysis Results

This study takes state-owned enterprises and private enterprises in Chengdu and Zigong cities of Sichuan Province as the scope of the study and 1559 enterprises as the survey respondents to explore the impact of intellectual property protection on enterprise innovation. To achieve this goal, the researchers collected 505 questionnaires, of which 502 were valid. This chapter presents the results of the quantitative analyses of the questionnaires and demographic information, as well as the results of the measurement model, structural model and hypotheses. The data were analysed using SmartPLS software for PLS-SEM analysis and SPSS software to further validate the models and

assess common methodological biases. The assessments confirmed the validity and reliability of the structural models and whether the path coefficients in the models were significant. Based on these analyses, three hypotheses proposed by the researchers were supported.

4.8 Summary of the Qualitative Research

4.8.1 Question 1 "What is your Opinion of the Current Policy on Intellectual Property Protection? Do you Think it is Good Enough?"

Table 4.26 Interviews with "What is your opinion of the current policy on intellectual property protection? Do you think it is good enough?"

Interview Respondents	Review of key points
Interviewee 1	“Escort”, “Thunder”, “Lightning” and “Sword Net”, to a large extent, the creation, protection and application of intellectual property rights have been strengthened, providing a strong legal guarantee for a firm's innovation. The implementation of the policy and the regulatory mechanism can be further strengthened to ensure that the policy can really take root and play a greater role.
Interviewee 2	Especially in the field of information technology, Intellectual Property Protection Center and intellectual property rights protection and assistance centers, the policy has clear provisions on software copyright and database protection, which provide strong legal protection for the innovative achievements of firms. The crackdown on infringement and the penalty mechanism are not severe enough, resulting in some repeated infringements. At the same time, the process of reviewing, applying for and defending intellectual property rights is relatively cumbersome and needs to be further optimized to reduce the burden on firms and improve efficiency.
Interviewee 3	Current intellectual property protection policies play an important role in promoting innovation and protecting its achievements by providing firms with a clear legal framework and safeguards. The continuous emergence of new technologies has made the definition and protection of intellectual property more complex and difficult. The increase in transnational infringements also calls for greater efforts in international cooperation.

Table 4.26 Interviews with "What is your opinion of the current policy on intellectual property protection? Do you think it is good enough?" (Cont.)

Interview Respondents	Review of key points
Interviewee 4	The formulation and implementation of policies provide strong legal safeguards for innovative firms, with insufficient protection in emerging technology areas and limited efforts to combat transnational infringements. In addition, some firms may face cumbersome procedures and high costs in applying for and protecting intellectual property protection, which limits their incentives to innovate.
Interviewee 5	For specialty food R&D firms, it means that innovations can be better protected, reducing the risk of imitation and infringement, and helping them to establish a unique brand image in the market. In the field of specialty gourmet food, due to the specificity and complexity of the products, there are certain difficulties in defining and protecting intellectual property protection. More specific and detailed policies are needed to accommodate the characteristics of this field. Enforcement and defence of intellectual property rights need to be strengthened. International cooperation in intellectual property protection also needs to be strengthened.
Interviewee 6	With regard to the current policy on intellectual property protection, I believe that it has, to a large extent, provided the necessary safeguards for the innovative activities of firms. Enhanced the level of intellectual property protection through measures such as strengthening the protection of production factors, enhancing assessment and evaluation, and improving public relations and guidance. The system of intellectual property protection in some emerging areas is still not sound enough, and the infringement of intellectual property rights is still prohibited, which, to a certain extent, affects the innovation incentive of firms and their competitiveness in the market. In addition, the cost of defending intellectual property rights is still high, and it is more difficult for some small and medium-sized firms to defend their rights.

Table 4.26, in interviewee to the question "What is your opinion of the current policy on intellectual property protection? Do you think it is good enough?" The interviews are summarized below:

The six interviewees generally recognized the important role played by the current intellectual property protection policy in promoting innovation and protecting the fruits of innovation, providing a clear legal framework and strong legal protection for firms to innovate. However, they also pointed out the shortcomings of the policy in terms of implementation, regulation, examination process, intensity of infringement crackdown, and cross-border co-operation.

1. Policy implementation and regulation: Interviewees generally agreed that although the policy has achieved remarkable results, the implementation and regulatory mechanism still need to be strengthened to ensure that the policy can really take root and play a greater role.

2. Review process and cost of defending rights: Interviewees pointed out that the relatively cumbersome process of reviewing, applying for and defending intellectual property rights, as well as the high cost of defending rights, is a burden for some Small and Medium-sized Firms (SMEs), which restricts their motivation to innovate.

3. Efforts to combat infringement: In terms of combating IPR infringement, the interviewees believe that the current penalty mechanism is not severe enough, resulting in some repeated infringements. They called for increasing the crackdown on infringement and raising the cost of offences.

4. Protection in Emerging Areas: With the continuous emergence of new technologies, the definition and protection of intellectual property protection have become more complex and difficult. Interviewees pointed out that the current policy's intellectual property protection system in some emerging areas is not sound enough and needs to be further improved.

5. Transnational Co-operation and Law Enforcement: The increase in transnational infringement requires strengthening international co-operation. Interviewers believe that in transnational intellectual property protection, it is necessary

to strengthen international co-operation to jointly combat infringement and protect the legitimate rights and interests of firms.

6. Protection in Specific Fields: For specific fields such as speciality cuisine, interviewees pointed out that there are certain difficulties in defining and protecting intellectual property protection, and that more specific and detailed policies are needed to adapt to the characteristics of these fields.

In summary, although the current intellectual property protection policy has played an important role in promoting innovation and protecting the fruits of innovation, there are still many areas that need to be improved and perfected. Future policy formulation and implementation should pay more attention to such aspects as enforcement efforts, regulatory mechanisms, optimisation of the examination process, increased efforts to combat infringement, enhanced protection in emerging areas, and transnational cooperation and enforcement.

4.8.2 Question 2 "How is the Implementation of Intellectual Property Protection in your Firm? What Specific Protection Measures are in Place?"

Table 4.27 Interviews with "How is the implementation of intellectual property protection in your firm? What specific protection measures are in place?"

Interview Respondents	Review of key points
Interviewee 1	Intellectual property protection is regarded as a top priority, which is an important guarantee to ensure that the innovation achievements of the firm are duly rewarded and the core competitiveness of the firm is maintained. We have set up a special intellectual During the product development stage, we conduct a comprehensive sorting and assessment of the intellectual property rights that may be involved to ensure that we do not infringe upon the intellectual property rights of others. Before our products are launched on the market, we conduct pre-trial and risk assessment of intellectual property rights to ensure the legitimacy of our products. At the same time, we will also monitor and combat infringing behaviours in the market to safeguard the legitimate rights and interests of the firm.

Table 4.27 Interviews with "How is the implementation of intellectual property protection in your firm? What specific protection measures are in place?" (Cont.)

Interview Respondents	Review of key points
Interviewee 2	Intellectual property protection is regarded as a crucial aspect, and a comprehensive intellectual property management system has been established. Emphasis is placed on the application and authorization of intellectual property rights. The training and education of internal employees have been strengthened to enhance their awareness of and attention to intellectual property protection. Strengthened cooperation with suppliers and partners to jointly safeguard intellectual property rights. Strengthened technology protection measures. Mechanisms for intellectual property rights protection have been established.
Interviewee 3	Intellectual property protection is seen as key to technological innovation and commercial success. A comprehensive intellectual property management system has been established. Training and publicity of intellectual property rights have been strengthened. A safe and controlled R&D environment was provided for the R&D team to ensure that technical secrets in the R&D process were not disclosed. Confidentiality management of technical achievements was strengthened, and strict confidentiality review was conducted on key technologies and important achievements to ensure that only authorized personnel could access and use them. Co-operation with intellectual property professional organizations has been strengthened to obtain the latest information on intellectual property laws and policy developments in a timely manner, so that we can better respond to various intellectual property disputes. An early warning mechanism for intellectual property risks has also been established. By regularly assessing and analyzing the intellectual property risks faced by firms, potential intellectual property issues were identified and resolved in a timely manner.
Interviewee 4	Intellectual property protection has always been an aspect we attach great importance to. We have established a perfect intellectual property management system, strengthened the intellectual property awareness training of our staff, strictly managed confidentiality, patent application and protection, copyright registration and protection, trade secret protection, and actively participated in the intellectual property protection work promoted by Chengdu Municipal Government.

Table 4.27 Interviews with "How is the implementation of intellectual property protection in your firm? What specific protection measures are in place?" (Cont.)

Interview Respondents	Review of key points
Interviewee 4	Intellectual property protection has always been an aspect we attach great importance to. We have established a perfect intellectual property management system, strengthened the intellectual property awareness training of our staff, strictly managed confidentiality, patent application and protection, copyright registration and protection, trade secret protection, and actively participated in the intellectual property protection work promoted by Chengdu Municipal Government.
Interviewee 5	Attaches great importance to intellectual property protection, as it is directly related to the uniqueness and market competitiveness of our speciality food research and development production. Intellectual property protection is incorporated into the long-term development strategy of the firm, and a special intellectual property protection team has been set up to provide regular training to all staff on intellectual property protection, patent application, trademark protection, confidentiality agreement, contract management, monitoring and rights protection.
Interviewee 6	Intellectual property protection has always been an important part of technology research and development. A sound intellectual property management system has been established. Publicity and training on intellectual property rights have been strengthened. Timely applications for intellectual property protection such as patents, trademarks and copyrights for all R&D results has been made to ensure that our innovations can be protected by law. Meanwhile, we have also strengthened the confidentiality of our technology and carried out strict confidentiality measures for our core technologies to prevent them from being leaked and misappropriated. Strengthened intellectual property co-operation with partners. We have signed intellectual property co-operation agreements with our partners to clarify the rights and obligations of both parties and avoid intellectual property disputes.

Table 4.27, in interviewee to the question "How is the implementation of intellectual property protection in your firm? What specific protection measures are in place?" is summarized below:

The six interviewees generally indicated that in their firms, intellectual property protection is regarded as a crucial aspect, which plays a key role in safeguarding the core competitiveness of the firms and guaranteeing that the fruits of innovation are duly rewarded. The following are the specifics of their implementation of intellectual property protection work and specific protection measures:

1. Establishment of a sound intellectual property management system: all interviewees emphasized the importance of establishing a system to ensure the orderly implementation of intellectual property protection by formulating and improving the intellectual property management system.

2. Setting up specialized intellectual property management departments or teams: most firms among the interviewees have set up specialized intellectual property management departments or teams to take charge of comprehensive intellectual property protection and management work.

3. Enhancement of intellectual property training and education: Respondents generally mentioned that they have strengthened internal staff intellectual property training and education to raise their staff's awareness of and attention to intellectual property protection.

4. Application and authorization work: Interviewees said they attach importance to intellectual property application and authorization work to ensure that the firm's innovations are protected by law.

5. Technological protection measures: Some interviewees particularly mentioned technological protection measures, such as strengthening the confidentiality management of technological achievements, and conducting strict confidentiality reviews of key technologies and important achievements.

6. Monitoring and combating infringing behaviors: interviewees said they would monitor and combat infringing behaviors in the market to safeguard the legitimate rights and interests of firms.

7. Strengthening cooperation and agreement management: Interviewees mentioned cooperation with suppliers, partners and intellectual property professional organizations to jointly maintain the security of intellectual property rights and signing relevant agreements to clarify the rights and obligations of both parties.

8. Establishment of early warning mechanism: Some interviewees also established an early warning mechanism for intellectual property risks, so as to identify and solve potential intellectual property problems in time by regularly assessing and analyzing the intellectual property risks faced by their firms.

From the results of the interviews, it can be seen that the interviewees generally attach a high degree of importance to intellectual property protection and have adopted a variety of specific protection measures to ensure that their firms' innovations are duly protected and rewarded. These measures cover not only system construction, organizational establishment, training and education, but also a variety of aspects such as technology protection, cooperation management as well as risk early warning, showing the comprehensive and systematic nature of intellectual property protection by firms.

4.8.3 Question 3 "How do you Think Intellectual Property Protection Affects Firms' Willingness to Innovate? Can you Give us Some Examples?"

Table 4.28 Interviews with "How do you think intellectual property protection affects firms' willingness to innovate? Can you give us some examples?"

Interview Respondents	Review of key points
Interviewee 1	A sound intellectual property protection system can stimulate the innovation vitality of a firm and enhance its core competitiveness, thus promoting its continuous forward development. In recent years, our firm has made important innovations in a number of fields and successfully applied for a series of patents and trademarks. The acquisition of these intellectual property rights not only enhances the brand image and market competitiveness of the firm, but also lays a solid foundation for the long-term development of the firm.

Table 4.28 Interviews with "How do you think intellectual property protection affects firms' willingness to innovate? Can you give us some examples?" (Cont.)

Interviewee 2	Intellectual property protection has a crucial impact on a firm's willingness to innovate. We have invested substantial capital and human resources in the development of a new intelligent data analysis system. Thanks to our comprehensive intellectual property protection measures, including patent applications and confidentiality agreements, we were able to ensure that the core technology and algorithms of this system were not illegally acquired by competitors. This protection allowed us to focus more on technological innovation during the research and development process, and we eventually succeeded in launching a product with market competitiveness.
Interviewee 3	Intellectual property protection plays a key role in stimulating the willingness of firms to innovate, promoting technological innovation and maintaining competitive advantage. Our firm has developed a new type of electrical control system, which has significantly improved in performance compared with traditional systems. We have applied for patent protection in time to ensure that our innovations will enjoy exclusivity for a period of time and cannot be imitated by other firms at will. This will provide a sufficient period of protection for our innovation, giving us enough time to promote and apply the result, thus gaining more economic benefits and market recognition.
Interviewee 4	We have invested a lot of human, material and financial resources to develop innovative service technology. During the R&D process, we focused on intellectual property protection and applied for relevant patents and copyrights in a timely manner. This intellectual property protection gives us more confidence and motivation to continue to invest in R&D because we know that these achievements will be protected by law and will not be easily stolen or imitated by others. I believe that intellectual property protection has a crucial impact on a firm's willingness to innovate. Only in a market environment where intellectual property protection is fully protected can firms be more confident and motivated to innovate and experiment and promote the progress and development of the entire industry.

Table 4.28 Interviews with "How do you think intellectual property protection affects firms' willingness to innovate? Can you give us some examples?" (Cont.)

Interview Respondents	Review of key points
Interviewee 5	Intellectual property protection is not only related to the economic interests of firms, but also a key factor in stimulating the innovation vitality of firms and promoting the progress of the industry. We have successfully developed a popular specialty food and applied for relevant patents and trademarks. This not only gives our product a unique competitive advantage in the market but also brings us considerable economic benefits. These gains further motivate us to increase our investment in innovation and drive the sustainable development of our firm.
Interviewee 6	Intellectual property protection not only protects the innovation achievements of firms, but also stimulates the innovation drive of firms, thus enhancing their market competitiveness. We have always been committed to technological research and development and have invested a lot of money and human resources in innovation activities. In this process, we pay great attention to intellectual property protection. We actively apply for intellectual property rights such as patents, trademarks and copyrights to ensure that our innovations are effectively protected. As our innovations are effectively protected and our willingness to innovate is greatly stimulated, we continue to launch new innovative products and technologies, which have won wide recognition in the market.

Table 4.28, in response to the question "How do you think intellectual property protection affects firms' willingness to innovate? Can you give us some examples?" The interviews are summarized below:

Interviewees generally agree that intellectual property protection has a crucial impact on firms' willingness to innovate. They agreed that a sound intellectual property protection system can stimulate innovation and enhance the core competitiveness of firms, thus driving them forward. The following are the specific examples and illustrations they provided:

1. Legal protection of innovative achievements: Interviewees mentioned the role of intellectual property protection in legally protecting the innovation achievements of firms. For example, Interviewee 1 mentioned that their firm had successfully applied for a series of patents and trademarks, and the acquisition of these intellectual property rights not only enhanced the firm's brand image and market competitiveness but also laid a solid foundation for the firm's long-term development.

2. Stimulate innovation: intellectual property protection can provide motivation and confidence for firms to innovate. Interviewee 2, when developing a new type of intelligent data analysis system, was able to ensure that the core technology was not illegally acquired due to its sound intellectual property protection measures, thus focusing more on technological innovation. Interviewee 4 also mentioned that they invested a lot of resources in R&D and applied for patents and copyrights in a timely manner, and these protections gave them more confidence and motivation to continue to invest in R&D.

3. Maintaining competitive advantage: Intellectual property protection ensures that firms enjoy exclusive rights to their innovations for a period of time, thus maintaining a competitive advantage. Both Interviewee 3 and Interviewee 5 mentioned their successful applications for patents and trademarks. This intellectual property protection not only gave their products a unique competitive edge in the market, but also brought them considerable financial gains, further motivating them to invest more in innovation.

4. Promoting the progress of the whole industry: Interviewee 4 also mentioned that in a market environment with adequate intellectual property protection, firms are able to be more confident and motivated to innovate and experiment, which will promote the progress and development of the whole industry.

In summary, intellectual property protection has a positive impact on firms' willingness to innovate by providing them with legal protection, stimulating innovation, maintaining a competitive edge, and contributing to the progress of the industry as a whole. This is further supported by the concrete examples provided by the interviewees.

4.8.4 Question 4 "Does Intellectual Property Protection help to Improve Firms' Ability to Innovate and Innovation Efficiency? Please Share your Experience."

Table 4.29 Interviews with "Does intellectual property protection help to improve firms' ability to innovate and innovation efficiency? Please share your experience."

Interview Respondents	Review of key points
Interviewee 1	Intellectual property protection can stimulate innovation in firms. Intellectual property protection helps to enhance the innovation drive of firms. Intellectual property protection also helps to optimize the allocation of innovation resources in firms. Intellectual property protection can improve the innovation efficiency of firms. We have set up a special intellectual property management department, which is responsible for the application, maintenance and management of intellectual property rights. At the same time, we have also strengthened intellectual property training and education for our employees to raise their awareness of intellectual property protection. The implementation of these measures has enabled us to effectively protect our innovations and improve our innovation ability and innovation efficiency.
Interviewee 2	Intellectual property protection helps to stimulate innovation in firms. Intellectual property protection helps firms develop unique technological advantages. We have successfully developed a cloud computing platform with independent intellectual property rights. It ensured that the core technology and algorithms of the platform were not leaked. This cloud computing platform has gained wide recognition in the market and brought considerable benefits to the firm. Intellectual property protection can also improve the innovation efficiency of a firm.
Interviewee 3	Intellectual property protection can significantly enhance a firm's ability to innovate. Intellectual property protection also helps to enhance the innovation efficiency of a firm. We made a breakthrough in key technology and successfully applied for patent protection. This not only gives us a competitive advantage in the market but also inspires the team to continue in-depth research and development.

Table 4.29 Interviews with "Does intellectual property protection help to improve firms' ability to innovate and innovation efficiency? Please share your experience." (Cont.)

Interview Respondents	Review of key points
Interviewee 3	Intellectual property protection can significantly enhance a firm's ability to innovate. Intellectual property protection also helps to enhance the innovation efficiency of a firm. We made a breakthrough in key technology and successfully applied for patent protection. This not only gives us a competitive advantage in the market but also inspires the team to continue in-depth research and development.
Interviewee 4	Intellectual property protection can create a secure and stable innovative environment for firms. Intellectual property protection can motivate firms to engage in continuous technological innovation. Intellectual property protection helps to enhance the innovation efficiency of a firm. My firm has achieved a number of innovations in the field of service technology development and has successfully applied for a number of patents and copyrights. These intellectual property protections not only allow our technological achievements to be fully recognized and protected but also bring us more business opportunities and competitive advantages.
Interviewee 5	Intellectual property protection significantly improves firms' ability to innovate. Intellectual property protection also significantly improves the innovation efficiency of firms. Intellectual property protection not only makes our specialty food more competitive in the market but also allows us to establish a good reputation and brand image in the industry. Our consumers trust our products more and are willing to pay for our innovations.
Interviewee 6	Intellectual property protection provides incentives for our firms to continue to invest resources in research and development. Intellectual property protection helps our firm to form technological barriers. We have successfully applied for a patent for a core technology, which not only protects our technological achievements, but also enables us to occupy a favorable position in the competition with our competitors. Our customers also have more trust and recognition of our products and services after seeing that we have strong intellectual property protection. Intellectual property protection also helps our firm to connect with the international market.

Table 4.29: Responding to the question "Does intellectual property protection help to improve firms' ability to innovate and innovation efficiency? Please share your experience." The interviews are summarized below:

Interviewees generally agree that intellectual property protection has a positive effect on enhancing firms' innovation capacity and innovation efficiency. Through their own experiences and practices, they elaborated on the specific impact of intellectual property protection in promoting innovation.

1. Stimulating enthusiasm and motivation for innovation: All interviewees indicated that intellectual property protection can stimulate firms' enthusiasm and motivation for innovation. Both Interviewee 1 and Interviewee 2 emphasized the role of intellectual property protection in enhancing firms' motivation to innovate, and Interviewee 1 also mentioned the importance of intellectual property protection in optimizing the allocation of innovation resources.

2. Formation of technological advantages and market competitiveness: Interviewee 2 and Interviewee 5 illustrate through specific cases that intellectual property protection helps firms to form unique technological advantages and gain competitive advantages in the market. The cloud computing platform mentioned by Interviewee 2 and the case of specialty food by Interviewee 5 demonstrate the role of intellectual property protection in forming a firm's unique competitiveness.

3. Enhancing Innovation Efficiency: Most interviewees mentioned the role of intellectual property protection in enhancing innovation efficiency. Interviewee 1 noted that the innovation efficiency of firms has been improved by setting up specialized intellectual property management departments and strengthening staff training in intellectual property. Interviewee 3 and Interviewee 4 also demonstrated the practical effects of intellectual property protection in enhancing innovation efficiency through successful cases in the areas of technological breakthroughs and service technology development respectively.

4. Creating a secure and stable innovation environment: Interviewee 4 mentioned that intellectual property protection can create a secure and stable innovation environment for firms. In such an environment, firms are able to focus more on

technological innovation without worrying about their innovations being illegally stolen or imitated.

5. Integration with international markets: Interviewee 6 specifically mentioned the role of intellectual property protection in helping firms integrate with international markets. By strengthening intellectual property protection, firms can more easily build trusting relationships with international partners and expand into international markets.

In summary, the interviewees generally agreed that intellectual property protection has a positive effect on enhancing firms' innovation capacity and innovation efficiency. Through their practical experiences and cases, they elaborated on the specific impact of intellectual property protection in promoting innovation, including stimulating enthusiasm for innovation, forming technological advantages, enhancing innovation efficiency, creating a safe and stable innovation environment, and connecting with international markets.

4.8.5 Question 5: "How does your Firm Combine Intellectual Property Protection Strategies with Technological Innovation? How has this Combination had a Positive Impact on the Firm's Innovation?"

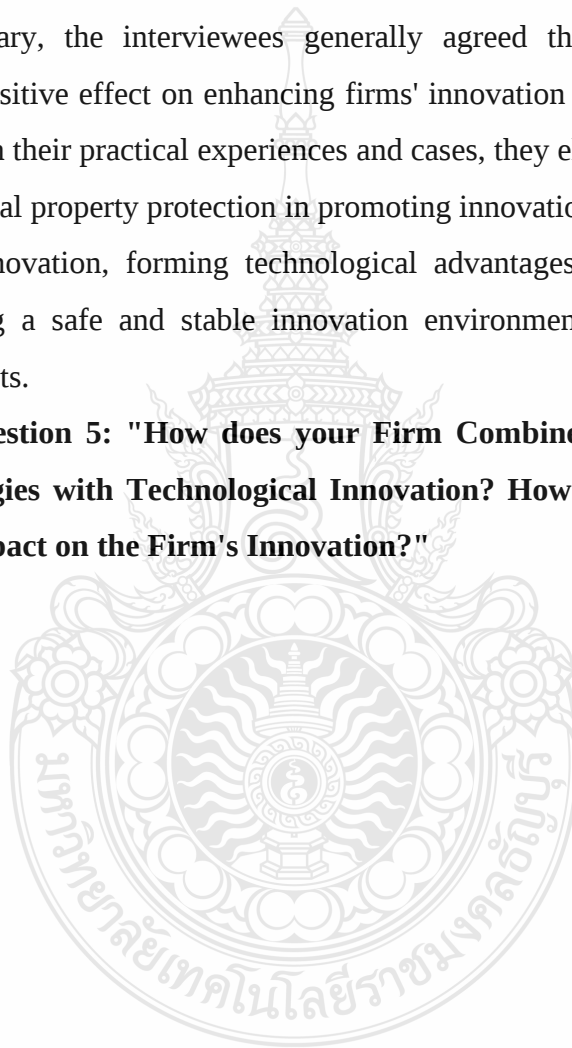


Table 4.30 Interviews with "How does your firm combine intellectual property protection strategies with technological innovation? How has this combination had a positive impact on the firm's innovation?"

Interview	Review of key points
Respondents	
Interviewee 1	Combining intellectual property protection strategies with technological innovation is the key to achieving long-term competitiveness and sustained innovation in a firm. Our firm has established a comprehensive intellectual property management system. Strengthen the awareness of intellectual property protection among employees. It has also done to deepen the integration of technological innovation and intellectual property protection. In the process of technological innovation, the firm focuses on integrating intellectual property protection strategies into all aspects of R&D, design and production. At the same time, it strengthens the cooperation with external institutions. For the positive impact, I think it is still very helpful. For example, it enhances the core competitiveness of firms; stimulates employees' motivation to innovate; promotes the transformation and application of technological innovation results; and strengthens trust and cooperation with partners.
Interviewee 2	Intellectual property protection strategies and technological innovation go hand in hand. We regard intellectual property protection as an important support for technological innovation, while technological innovation is the source of intellectual property protection. We set up specialised intellectual property management departments; strengthen internal training; and formulate incentive policies. This combination of intellectual property protection strategies and technological innovation has had the following positive impact on firms' innovation: stimulate innovation; enhance innovation efficiency; strengthen firms' competitiveness; and promote the sharing of innovation resources.

Table 4.30 Interviews with "How does your firm combine intellectual property protection strategies with technological innovation? How has this combination had a positive impact on the firm's innovation?" (Cont.)

Interview	Review of key points
Respondents	
Interviewee 3	Intellectual property protection strategy and technological innovation are closely integrated, and together they drive the firm forward. We integrate intellectual property protection strategy into the technological innovation process of the firm. We focus on the transformation and application of intellectual property rights. This combination of intellectual property protection strategy and technological innovation has had a positive impact on the innovation of the firm. Specifically: it enhances the innovation drive of the firm; strengthens the core competitiveness of the firm; and promotes the continuous innovation of technology.
Interviewee 4	We are aware of the importance of the close integration between intellectual property protection strategies and technological innovation for the development of a firm. Our firm attaches great importance to the formulation and implementation of intellectual property protection strategies. The close integration of intellectual property protection and technological innovation has created a virtuous circle of mutual promotion. Specifically, this combination has the following positive effects on firm innovation: it enhances the firm's willingness and motivation to innovate; it improves the firm's innovation efficiency; and it enhances the firm's core competitiveness.

Table 4.30 Interviews with "How does your firm combine intellectual property protection strategies with technological innovation? How has this combination had a positive impact on the firm's innovation?" (Cont.)

Interview	Review of key points
Respondents	
Interviewee 5	The combination of intellectual property protection strategy and technological innovation is a crucial link. This combination not only ensures that the speciality food we develop can receive effective legal protection, but also provides a firm with solid protection and sustained momentum for technological innovation. At the early stage of R&D, we incorporate intellectual property protection into the entire R&D process. During the R&D process, we will strictly protect all innovative points. At the same time, we will also sign confidentiality agreements with suppliers, partners, etc. After the R&D results are launched in the market, we will continue to strengthen intellectual property protection. This combination of intellectual property protection strategies and technological innovation has had a positive impact on firm innovation. Firstly, it stimulates the innovation drive of the firm. Secondly, it improves the innovation efficiency of firms. Finally, it enhances the competitiveness of firms.
Interviewee 6	We understand the importance of combining intellectual property protection strategies with technological innovation. We have incorporated intellectual property protection strategies into our firm's strategic planning. We have strengthened the training and publicity of intellectual property protection. In the process of technology research and development, we require the R&D team to consider the issue of intellectual property protection when setting up a project; in the process of technological innovation, we encourage our employees to actively apply for patents; and in the process of transforming and applying technological achievements, we focus on intellectual property co-operation with our partners. This combination of intellectual property protection strategy and technological innovation has had a positive impact on the firm's innovation: it has improved the firm's innovation ability and innovation efficiency; it has enhanced the firm's core competitiveness; and it has facilitated the flow and exchange of innovation resources.

Table 4.30, in response to the question "How does your firm combine intellectual property protection strategies with technological innovation? How has this combination had a positive impact on the firm's innovation?" The interviews are summarized below:

There is a general consensus among the interviewees that combining intellectual property protection strategies with technological innovation is a key element for the success of innovation in their firms. Their respective firms have taken different measures to realize this combination and it has had a positive impact on firms' innovation.

Methods of combining intellectual property protection strategies with technological innovation:

1. Establishing a sound intellectual property management system: Interviewees generally mentioned the establishment of a sound intellectual property management system to ensure that intellectual property can be systematically protected and managed in the process of technological innovation.

2. Strengthening employees' awareness of intellectual property protection: Through internal training and publicity, employees' knowledge and awareness of intellectual property protection are enhanced to ensure that they can consciously comply with intellectual property regulations in the process of technological innovation.

3. Integrate intellectual property protection into the R&D process: incorporate intellectual property protection into the whole R&D process from the early stage of R&D, strictly protect all innovation points, and sign confidentiality agreements with suppliers and partners.

4. Focus on the transformation and application of intellectual property protection: Encourage employees to actively apply for patents, focus on the transformation and application of technological achievements, and ensure that innovative achievements can be fully protected and utilized.

5. Strengthening external cooperation: establishing cooperative relationships with universities, research institutes and other external institutions to jointly carry out technological research and development and intellectual property protection, so as to achieve resource sharing and complementary advantages.

Combining the positive impact on firm innovation:

1. Stimulate innovation motivation: the combination of intellectual property protection strategy and technological innovation can stimulate the innovation motivation of the firm and make the employees more actively involved in technological innovation.
2. Enhance innovation efficiency: through perfect intellectual property management system and process, firms can protect and manage innovation achievements more efficiently and improve innovation efficiency.
3. Enhance the competitiveness of firms: effective intellectual property protection can protect the core technology of firms from being imitated and stolen by competitors and enhance the market competitiveness of firms.
4. Promote the sharing of innovative resources: cooperation with external institutions can promote the flow and exchange of innovative resources, achieve resource sharing and complementary advantages, and further promote the innovative development of the firm.
5. Enhance the core competitiveness of the firm: the combination of intellectual property protection and technological innovation can form the unique competitive advantages of the firm and enhance the core competitiveness of the firm.

To sum up, the combination of intellectual property protection strategy and technological innovation of firms is the key to achieving continuous innovation and enhance competitiveness. By establishing a perfect intellectual property protection management system, strengthening the awareness of employees, integrating protection into the R&D process, focusing on transformation and application, and strengthening external cooperation, firms can give full play to the positive role of intellectual property protection and promote the in-depth development of innovative activities.

4.8.6 Question 6 "Can you Share some Examples of Changes in your Firm's Technological Innovation Triggered by Adjustments in your Intellectual Property Protection Strategy?"

Table 4.31 Interviews with "Can you share some examples of changes in your firm's technological innovation triggered by adjustments in your intellectual property protection strategy"

Interview	Review of key points
Respondents	
Interviewee 1	Our firms are also engaged in the creation and sale of some cultural products. In the past, our cultural products often suffered from piracy and infringement due to ineffective copyright protection. To change this situation, we have optimised our copyright protection strategy, stepped up our efforts to combat infringement and strengthened our cooperation with the cultural and creative industries.
Interviewee 2	In the past, although our firm also attached importance to technological innovation, we were relatively weak in intellectual property protection, which led to some of our technological achievements being quickly imitated by our competitors after their release, making it difficult to maintain our technological advantages. When one of our R&D teams was developing a new big data analysis platform, they actively cooperated with the intellectual property management department, and carried out patent mining and layout at the early stage of R&D. As the R&D progressed, they successfully applied for a series of patents related to the platform, which covered the core technology and key algorithms of the platform. When this new big data analysis platform was launched to the market, competitors could not easily imitate it as we have independent intellectual property rights.
Interviewee 3	In the past, although our firm invested a lot of resources in electrical technology R&D, it lacked systematic planning in patent application and layout. In order to change this situation, we have adjusted our intellectual property protection strategy and strengthened our focus and planning on patent application. After this series of strategic adjustments, our patent layout has been significantly optimised. In the past, we did not pay enough attention to the protection of trademarks, which led to the frequent occurrence of some brand-related infringements. In order to strengthen our trademark protection, we have reorganised our brand system and clarified the scope of trademark registration and use norms. The strengthening of trademark protection has not only enhanced the popularity and reputation of our brands, but also strengthened consumers' trust and loyalty to our brands.

Table 4.31 Interviews with "Can you share some examples of changes in your firm's technological innovation triggered by adjustments in your intellectual property protection strategy" (Cont.)

Interview	Review of key points
Respondents	
Interviewee 4	In the past, although our firms also attached importance to technological innovation, they were relatively weak in intellectual property protection. This led to some technological achievements being imitated or copied by other firms after the completion of research and development because they were not protected in a timely and effective manner. In order to change this situation, our firm has decided to adjust its intellectual property protection strategy and closely integrate it with technological innovation. Take a smart service system we recently developed as an example, the system received strict intellectual property protection during the development process. We applied for relevant patents and copyrights in a timely manner to ensure the uniqueness and exclusivity of the technology. This has given us an edge in market competition and successfully attracted the attention of many customers.
Interviewee 5	Our R&D team successfully developed a speciality dish a few years ago that combines local traditional craftsmanship with modern cooking techniques. In order to ensure that this innovation is not imitated by competitors, we promptly applied for patent protection. In the process of food preparation, unique cooking techniques are the key factors in shaping the taste and flavour of a dish. We realised that if these processes were leaked or imitated, it would cause great losses to the firm. As the popularity of the firm increases, our speciality food brands are receiving more and more attention. To ensure that our brand image is not damaged, we have strengthened the protection of our brand trademark.
Interviewee 6	In the past, we have relied heavily on traditional forms of intellectual property protection, such as patent applications and trademark registrations. Now we are focusing on the protection of trade secrets by signing non-disclosure agreements and adopting physical and technical means to prevent technology leakage. In addition, we actively use copyright law to protect our innovations such as software, documentation and design solutions.

Table 4.31. Based on the results of the in-depth interviews, the answer to the question "Can you share some examples of changes in your firm's technological innovation triggered by adjustments in your intellectual property protection strategy?" is summarized below.

Interviewees shared a series of cases of changes in technological innovation in their firms as a result of adjustments in their intellectual property protection strategies, which demonstrated the important role of intellectual property protection strategies in promoting technological innovation in their firms and ensuring that the results of innovation are effectively protected.

1. Interviewee 1: A firm that creates and distributes cultural products. This firm suffered from piracy and infringement in the past. By optimizing its copyright protection strategy, it has stepped up its efforts to combat infringement and cooperated with the cultural and creative industries to improve the innovative environment, which has resulted in better protection of its cultural products.

2. Interviewee 2: Big Data Analysis Platform R&D Team. The team cooperated with the intellectual property management department at the early stage of research and development, conducted patent mining and layout, and successfully applied for a series of patents related to the platform, which protected the core technology and key algorithms of the platform, ensured the uniqueness and exclusivity of the technological achievements, and enabled the firm to gain an advantage in the market competition.

3. Interviewee 3: Electrical technology research and development firm. The firm previously lacked systematic patent planning and trademark protection. After the adjustment, it strengthened the attention and planning of patent applications and reorganized its brand system and strengthened trademark protection. These changes enhanced the firm's brand awareness and reputation and strengthened consumers' trust and loyalty to the brand.

4. Interviewee 4: Intelligent service system developer. The firm strictly protects intellectual property protection during the R&D process and timely applies for relevant patents and copyrights to ensure the uniqueness and exclusivity of its technology. This

strategy has given the firm an edge in market competition and successfully attracted many customers.

5. Interviewee 5: Specialty food brand. The firm successfully researched and developed a specialty dish that combines traditional craftsmanship with modern cooking techniques and applied for patent protection in time. At the same time, with the increase of the firm's popularity, it has strengthened the protection of the brand's trademark to ensure that the brand image is not damaged.

6. Interviewee 6: Technology-intensive firm. The firm shifted from traditional intellectual property protection to a more comprehensive protection strategy, including strengthening trade secret protection, signing confidentiality agreements and adopting physical technology means, as well as using copyright law to protect innovations such as software, documents and design solutions. These adjustments in strategy have ensured the security of the firm's technology and the rights and interests of its innovations.

In summary, these cases show the important impact of the adjustment of intellectual property protection strategies on the protection of firms' technological innovations and achievements. By optimizing copyright protection, strengthening patent layout, enhancing trademark protection, protecting trade secrets and utilizing copyright law, firms have not only enhanced their innovation ability and market competitiveness, but also ensured that their innovation achievements are effectively protected, which has brought them long-term competitive advantages.

4.8.7 Question 7 "Has Intellectual Property Protection Affected your Firm's R&D Capabilities? If so, how?"

Table 4.32 Interviews with "Has intellectual property protection affected your firm's R&D capabilities? If so, how?"

Interview Respondents	Review of key points
Interviewee 1	Intellectual property protection has had a significant impact on the R&D capability of our firms, enhancing the quality of R&D. This pursuit of R&D quality helps to improve the overall technological level and competitiveness of our firms. Enhancing market competitiveness, this competitive advantage not only brings higher market share and profits, but also helps firms to expand into new markets and business areas and achieve sustainable development.
Interviewee 2	Deeply affected by intellectual property protection strategies, especially in terms of R&D capabilities. Intellectual property protection has had a profound impact on our firm's R&D capabilities. Intellectual property protection provides a stable legal environment for our firm's R&D activities. Our R&D teams can devote themselves to R&D with greater confidence. Intellectual property protection promotes the transformation and application of our firm's innovations and further enhances our firm's R&D capability. Intellectual property protection enhances our investment confidence in technological innovation, and this increased investment confidence further enhances our R&D capabilities. Intellectual property protection also promotes co-operation between our firm and external partners, and this co-operation not only enhances our R&D capability, but also broadens our technological horizons and market channels.
Interviewee 3	Intellectual property protection has had a significant and positive impact on our firm's R&D capabilities. Incentivising innovation, this protection has greatly motivated our R&D teams to make more innovative attempts, knowing that their efforts will be duly rewarded and protected. Boosting willingness to invest in R&D, this financial benefit has driven our firms to increase their investment in R&D, further enhancing their R&D capabilities. Attracting and retaining talent, which not only attracts more talented people to join our R&D team, but also retains the existing core talent and ensures the stability and continuity of the R&D team. Promote technology co-operation and transfer. Intellectual property protection promotes the smooth progress of technology co-operation and transfer. Improve R&D efficiency. Under intellectual property protection, the R&D team can focus more on the R&D work itself without worrying about the innovation being stolen or imitated by others.

Table 4.32 Interviews with "Has intellectual property protection affected your firm's R&D capabilities? If so, how?" (Cont.)

Interview Respondents	Review of key points
Interviewee 4	Intellectual property protection has indeed had a profound impact on the R&D capabilities of our firms. Intellectual property protection strengthens the R&D drive of our firms. This protection gives us more confidence and motivation to invest more resources in technological R&D, in the knowledge that these investments will be transformed into legally protected assets that will bring long-term returns. Intellectual property protection promotes the accumulation and application of technology, through which our R&D capability is further enhanced. Intellectual property protection enhances the market competitiveness of the firm, and this enhanced competitiveness further stimulates our R&D drive and promotes continuous innovation. Intellectual property protection promotes the formation of an innovative culture within the firm, and the formation of this innovative culture makes the employees more willing to invest time and energy in technological research and development and innovation attempts, thus promoting the improvement of the firm's overall R&D capability.
Interviewee 5	Intellectual property protection did have a significant impact on the R&D capabilities of my firm. Stimulating innovation. This protection stimulates the team's spirit and enthusiasm for innovation, further enhancing the firm's R&D capability. Guaranteeing return on R&D investment. This economic benefit incentive makes us more willing to invest more resources in R&D, forming a virtuous circle and further enhancing the R&D capability of our firm. Promote technological co-operation and exchanges. Such co-operation and exchanges not only enhance our R&D capability, but also bring more innovative inspiration and resource support to the firm. Enhance the competitiveness of the firm, this enhancement of competitiveness enables us to promote our products and services more confidently in the market, which further promotes the R&D and innovation of the firm.

Table 4.32 Interviews with "Has intellectual property protection affected your firm's R&D capabilities? If so, how?" (Cont.)

Interview Respondents	Review of key points
Interviewee 6	Intellectual property protection has indeed had a significant impact on my firm's R&D capabilities, and that impact has been positive and far-reaching. Firstly, intellectual property protection provides legal security for our R&D team, enabling them to devote themselves to innovation with greater confidence. Secondly, intellectual property protection facilitates collaboration between our firms and other firms and research organisations. In addition, intellectual property protection brings financial benefits to our firm. This economic incentive makes us more willing to invest more resources and funds in R&D work, further enhancing our R&D capability.

Based on the results of the in-depth interviews, the question "Has intellectual property protection affected your firm's R&D capabilities? If so, how?" is summarized below:

Intellectual property protection has had a significant and positive impact on the R&D capability of the interviewee firm. The specific impact is mainly reflected in the following aspects:

1. Enhancing R&D motivation: intellectual property protection provides firms with legal protection, which gives R&D teams more confidence and motivation to devote themselves to R&D work. They know that the innovation results will be protected by the law and thus feel more at ease to carry out R&D technology and innovation attempts.

2. Guarantee return on R&D investment: intellectual property protection ensures a return on a firm's R&D investment and reduces losses due to stolen or imitated results. This economic benefit incentive makes firms more willing to invest more resources and funds for R&D, forming a virtuous circle.

3. Promote technical cooperation and exchange: intellectual property protection promotes cooperation between firms and other enterprises and research institutions. Such co-operation not only enhances the firm's R&D capability but also brings more innovative inspiration and resource support to the firm. Through co-operation with external partners,

firms are able to acquire new technologies and market information more quickly, thus accelerating the R&D process.

4. Enhancement of firm competitiveness: Intellectual property protection enhances the market competitiveness of firms, enabling them to promote their products and services more confidently in the market. This enhanced competitiveness further stimulates the R&D motivation of the firm and promotes its continuous innovation.

5. Enhancement of R&D efficiency: In an environment of intellectual property protection, the R&D team can focus more on the R&D work itself without worrying about the innovation being stolen or imitated by others. This environment is conducive to the R&D team focusing on technology development and innovation attempts, thus improving R&D efficiency.

6. Promote the formation of an innovative culture within the firm: intellectual property protection promotes the formation of an innovative culture within the firm. This innovation culture makes employees more willing to invest time and energy in technology research and development and innovation attempts, thus promoting the improvement of the overall R&D capability of the firm.

To sum up, intellectual property protection has a positive and far-reaching impact on the R&D capability of the interviewee's firms, which enhances the R&D motivation of the firms, guarantees the return on R&D investment, promotes technological co-operation and exchanges, strengthens the competitiveness of the firms, improves the efficiency of R&D, and facilitates the formation of an innovative culture within the firms.

4.8.8 Question 8 "How do you See the Positive or Negative Relationship between Intellectual Property Protection and R&D Capability? What are the Actual Data or Cases that Support your View?"

Table 4.33 Interviews with "How do you see the positive or negative relationship between intellectual property protection and R&D capability? What are the actual data or cases that support your view?"

Interview	Review of key points
Respondents	
Interviewee 1	There is a significant positive relationship between intellectual property protection and R&D capability. Firstly, intellectual property protection can motivate firms to increase their R&D investment and enhance their R&D capability. Secondly, intellectual property protection can bring competitive advantages to firms and further promote the improvement of R&D capability. According to the data of a state-owned firm in Chengdu, with the strengthening of intellectual property protection in recent years, the R&D investment of the firm has increased year by year, and the number of patent applications has also shown a rapid growth trend. These innovations have not only enhanced the technical level of the firm, but also brought significant economic benefits to the firm.
Interviewee 2	I firmly believe that there is a positive and mutually reinforcing relationship between intellectual property protection and R&D capabilities. Firstly, intellectual property protection provides strong legal protection for R&D capability. Secondly, intellectual property protection promotes the transformation and application of R&D results. In regions or countries with better intellectual property protection, the R&D investment and innovation capacity of firms are generally higher. This is because intellectual property protection reduces the risks and costs of innovation, making firms more willing to invest in R&D resources.
Interviewee 3	I firmly believe that there is a clear positive relationship between intellectual property protection and R&D capability. Intellectual property protection ensures that a firm's R&D results are not easily copied or stolen by others, reducing the risk of innovation and thus encouraging firms to increase their R&D investment. We have increased our investment in intellectual property protection and established a comprehensive intellectual property protection system. This initiative has not only improved the level of intellectual property protection in our firm, but also stimulated the innovation of our R&D team.

Table 4.33 Interviews with "How do you see the positive or negative relationship between intellectual property protection and R&D capability? What are the actual data or cases that support your view?" (Cont.)

Interview Respondents	Review of key points
Interviewee 4	There is a clear positive relationship between intellectual property protection and R&D capabilities. Intellectual property protection ensures that a firm's R&D results are not illegally copied or imitated, reducing the risks and costs of innovation. In industries such as pharmaceuticals and chemicals, the need for intellectual property protection is more pressing for firms due to the complexity and high risk of technological innovation. In these industries, firms with better intellectual property protection tend to be more willing to invest resources in technological innovation and are able to achieve better performance in the market.
Interviewee 5	As a manager of a privately owned firm in Zigong, Sichuan Province, which specialises in research, development and production of speciality food, I am convinced that there is a clear positive relationship between intellectual property protection and R&D capability. Intellectual property protection ensures that a firm's innovations are legally protected from being stolen or imitated by others. Firms that take intellectual property protection seriously tend to invest more in R&D and produce more innovations. These firms are often able to quickly turn their innovations into actual products and gain a competitive advantage in the marketplace.
Interviewee 6	I believe that there is a positive and close relationship between intellectual property protection and R&D capability. First, intellectual property protection provides legal protection for firms' R&D activities. Secondly, intellectual property protection helps firms to accumulate technical assets and form technical barriers. Taking high-tech industries as an example, these industries have a more urgent need for intellectual property protection. In these industries, firms with a higher degree of intellectual property protection tend to have stronger R&D capabilities and higher market competitiveness. However, it is also argued that intellectual property protection may have a negative impact on firms' R&D capabilities. For example, overly stringent intellectual property protection may hinder the dissemination and application of technology and limit the room for firms to innovate. However, in my understanding, this negative impact is not an inevitable consequence of intellectual property protection, but rather a matter that needs to be balanced and regulated in practice.

Table 4.33 Based on the results of the in-depth interviews, the question "How do you see the positive or negative relationship between intellectual property protection and R&D capability? What are the actual data or cases that support your view?" are summarized below:

All six interviewees agreed that there is a significant positive relationship between intellectual property protection and R&D capability. They generally agreed that intellectual property protection motivates firms to invest more in R&D, enhances R&D capability, and provides firms with a competitive advantage. The following is a detailed summary of the views of each interviewee and their supporting data:

1. interviewee 1:

Opinion: There is a positive relationship between intellectual property protection and R&D capability.

Supporting data: Data from a state-owned firm in Chengdu shows that with the strengthening of intellectual property protection, the firm's R&D investment has increased year by year, and the number of patent applications has also grown rapidly.

2. Interviewee 2:

Opinion: Intellectual property protection and R&D capability promote each other.

Reason: Intellectual property protection provides legal protection for R&D capability and promotes the transformation and application of R&D results.

General observation: In regions or countries with good intellectual property protection, firms' R&D investment and innovation capacity are generally higher.

3. Interviewee 3:

Observation: There is a clear positive relationship between intellectual property protection and R&D capability.

Reason: Intellectual property protection reduces innovation risk and encourages firms to increase R&D investment.

Business practice: firms increase investment in intellectual property protection and stimulate innovation in R&D teams.

4. interviewee 4:

Opinion: there is a clear positive relationship between intellectual property protection and R&D capability.

Reason: Intellectual property protection reduces innovation risks and costs, especially in high-risk industries such as pharmaceuticals and chemicals.

Industry observation: firms with better intellectual property protection are more willing to invest resources in technological innovation and gain an edge in the market.

5. interviewee 5:

Opinion: There is a clear positive relationship between intellectual property protection and R&D capability.

Rationale: Intellectual property protection ensures that innovations are legally protected against theft or imitation.

Firm Case: Firms that value intellectual property protection usually have higher R&D investment and more innovations.

6. Interviewee 6:

Opinion: There is a positive and close relationship between intellectual property protection and R&D capability.

Reason: Intellectual property protection provides legal protection for R&D activities and helps accumulate technological assets and form technological barriers.

Industry analysis: High-tech industries have an urgent need for intellectual property protection, and firms with a high degree of protection have stronger R&D capabilities and market competitiveness.

Balance of negative impacts: Although it is argued that overly stringent intellectual property protection may impede technology diffusion, the interviewees believe that this needs to be balanced and moderated in practice.

In summary, all interviewees emphasized the positive relationship between intellectual property protection and R&D capabilities and supported their views with practical data, case studies and industry observations. They believe that intellectual property protection not only incentivizes firms to invest more in R&D, but also gives

them a competitive advantage and facilitates the translation and application of R&D results.

4.8.9 Question 9 "What Innovations in your Firm have Benefited from Intellectual Property Protection? Please Describe them in Detail."

Table 4.34 Interviews with "What innovations in your firm have benefited from intellectual property protection? Please describe them in detail"

Interview Respondents	Review of key points
Interviewee 1	Intelligent Manufacturing System: In recent years, our firm has invested a lot of resources to develop a set of intelligent manufacturing system with independent intellectual property rights. This system can significantly improve production efficiency, reduce production costs, and enhance product quality. As we have applied for a number of patents to protect the core technology of this system, we are able to ensure that competitors cannot easily copy or imitate it. This has given our firm a competitive edge in the market and brought significant economic benefits.
Interviewee 2	Intelligent Data Analysis Platform: In recent years, our team has successfully developed a high-performance intelligent data analysis platform. The platform uses advanced algorithms and big data processing technologies to achieve efficient analysis and deep mining of data, providing powerful support for firms' decision-making. Cloud Computing Service Optimisation Technology: In the field of cloud computing services, our team has carried out a number of optimisations in cloud computing services through technological innovation, including improving service efficiency, reducing energy consumption and enhancing security. Artificial Intelligence Assisted Development Tool: In order to meet the market demand for fast and efficient software development, our team has developed an artificial intelligence assisted development tool. Firm Information Security Protection System: With the increasing severity of cyber security issues, our team has invested a lot of resources to develop a firm information security protection system.

Table 4.34 Interviews with "What innovations in your firm have benefited from intellectual property protection? Please describe them in detail" (Cont.)

Interview	Review of key points
Respondents	
Interviewee 3	High-efficiency power conversion technology: We have successfully developed a high-efficiency power conversion technology that significantly improves power conversion efficiency and reduces energy loss. Smart Grid Management System: We have developed a smart grid management system, which realizes intelligent management and optimization of the power grid through big data and artificial intelligence technology. Environmentally friendly electrical material: In response to the national environmental protection policy, we have invested a lot of resources to develop an environmentally friendly electrical material. This material not only has good electrical performance, but also meets environmental standards and is friendly to the environment. Sharing of intellectual property in co-operative R&D projects: In our co-operative R&D projects with other firms, universities and research institutes, we focus on the sharing and protection of intellectual property.
Interviewee 4	Intelligent Data Analytics Platform: We have recently successfully developed an intelligent data analytics platform that provides accurate data insights and predictive analyses. Customized Service Solutions: Our team has developed a series of customized service solutions to address the needs of specific industries. Algorithm optimization technology: In the field of service technology development, algorithm optimization is the key to improving service quality and efficiency. International cooperation projects: in recent years, our firm has actively engaged in technical exchanges and cooperation with international partners. In the process of co-operating with foreign firms to develop new technologies and products, we pay great attention to intellectual property protection.

Table 4.34 Interviews with "What innovations in your firm have benefited from intellectual property protection? Please describe them in detail" (Cont.)

Interview Respondents	Review of key points
Interviewee 5	Patent protection for unique gourmet recipes: Our R&D team has developed a special gourmet recipe that combines traditional local flavors with modern cooking techniques. Trademark protection for specialty cooking techniques: Cooking techniques are a very critical part of the process of making specialty food. Copyright protection for food packaging design: As consumers are demanding more and more food packaging, our firm has increased its efforts to innovate in packaging design. Legal protection of the marketing mode combining online and offline: with the rapid development of the Internet, our firm also actively explores the marketing mode combining online and offline. We have developed an exclusive APP, through which consumers can place orders online and make dining reservations.
Interviewee 6	Core technology patent: In recent years, our team has successfully developed a core technology and applied for patent protection. Innovative product design: In the field of product design, we focus on integrating innovative ideas into our products. Trade secret protection: In the process of research and development, we have accumulated a large number of trade secrets and key technical information. Intellectual Property Co-operation: We actively co-operate with universities, research institutes and other firms on intellectual property. One typical case is our innovations in the field of intelligent robots.

Table 4.34 Based on the results of the in-depth interviews, for the question "What innovations in your firm have benefited from intellectual property protection? Please describe them in detail." is summarized below:

For question 9, "What innovations in your firm have benefited from intellectual property protection?" the interviews are summarized below:

1. interviewee 1:

Innovation: Intelligent Manufacturing System

Description: This intelligent manufacturing system can significantly improve production efficiency, reduce costs and improve product quality. Through a number of patent protections, it ensures that the core technology of the system is not copied or imitated by competitors, which has won the firm a competitive advantage in the market and economic benefits.

2.interviewee 2:

Innovative achievements:

1) Intelligent Data Analysis Platform

Description: using advanced algorithms and big data processing technology to provide efficient data analysis and deep mining to support firm decision-making.

2) Cloud Computing Service Optimization Technology

Description: optimizes cloud computing services to improve service efficiency, reduce energy consumption and enhance security.

3) Artificial Intelligence Assisted Development Tools

Description: Satisfy with the need of rapid and efficient software development.

4) Firm Information Security Protection System

Description: To cope with network security problems and protect firm information security.

3.Interviewee 3:

Innovative Achievements:

1) High-efficiency Power Conversion Technology

Description: Significantly improve power conversion efficiency and reduce energy loss.

2) Smart Grid Management System

Description: intelligent management and optimization of power grid through big data and artificial intelligence technology.

3) Environmentally friendly electrical materials

Description: Responding to the environmental protection policy, we develop environmentally friendly electrical materials, which are friendly to the environment.

4) Intellectual Property Sharing in Co-operative R&D Projects

Description: Focus on intellectual property protection and sharing in collaborative R&D projects.

4.interviewee 4:

Innovative achievements:

1) Intelligent Data Analysis Platform

Description: provides accurate data insights and predictive analyses.

2) Customized Service Solutions

Description: develop customized services for specific industry needs.

3) Algorithm Optimization Technology

Description: Improve service quality and efficiency.

4) International Co-operation Projects

Description: Focus on intellectual property protection in cooperation with foreign firms.

5. interviewee 5:

Innovative achievements:

1) Patent Protection of Unique Gourmet Recipes

Description: distinctive gourmet recipes combining traditional flavors with modern cooking techniques.

2) Trademark protection of specialty cooking techniques

Description: protection of key culinary processes in gourmet food production.

3) Copyright protection for food packaging design

Description: Innovative food packaging design to meet consumer needs.

4) Legal protection of online and offline combined marketing mode

Description: Using exclusive APP to realize the marketing mode of combining online and offline.

6. Interviewee 6:

Innovative achievements:

1) Core technology patents

Description: Successfully developed core technology and applied for patent protection.

2) Innovative product design

Description: integrate innovative ideas into product design.

3) Trade Secret Protection

Description: Protect trade secrets and key technical information in the R&D process.

4) Cooperation on Intellectual Property

Description: Intellectual property co-operation with universities, research institutes and other firms, e.g. innovations in the field of intelligent robotics.

To summarize, the interviewees' firms have achieved innovations in a number of fields and have ensured the market competitiveness and economic benefits of these achievements through intellectual property protection. These innovations not only cover a wide range of technologies, products and services, but also reflect the importance and investment of firms in intellectual property management.

In addition, the People's Government of Sichuan Province provides a provincial intellectual property operating fund for all firms. In order to better support intellectual property innovation, Sichuan Province has taken the lead in setting up a Provincial Intellectual Property Operating Fund, the size of which has reached an impressive CNY 686 million. This fund is designed to provide adequate financial support to firms and to promote the innovation and utilization of intellectual property rights.

4.8.10 Question 10 "Has Intellectual Property Protection Contributed to the Commercialization of your Firm's Innovations? Can you Provide Examples?"

Table 4.35 Interviews with "Has intellectual property protection contributed to the commercialization of your firm's innovations? Can you provide examples?"

Interview	Review of key points
Respondents	
Interviewee 1	Intellectual property protection does contribute significantly to the commercialization of our firm's innovations. Brand building and maintenance: our trademark and brand image are effectively protected under the framework of intellectual property protection. Collaborative R&D: Intellectual property protection also opens up more possibilities for our firm in terms of collaborative R&D. Market access and competitive strategies: intellectual property protection makes our innovations more competitive in the market. Take, for example, a smart home product recently launched by our firm, which integrates a number of innovative technologies and is protected by a number of patents. Before launching the product in the market, we took advantage of the strategy of intellectual property protection to establish co-operative relationships with a number of channel providers and partners to jointly promote the product. Due to the uniqueness of the product and its technological advantages, the product was quickly recognized by consumers in the market and achieved good sales results. This example fully illustrates the importance of intellectual property protection for the commercialization of a firm's innovations.
Interviewee 2	Intellectual property protection does greatly assist in the commercialization of our firms' innovations. Firstly, intellectual property protection provides legal protection for our innovations and reduces the risk of illegal copying or imitation by others. Secondly, intellectual property protection helps us to build trusting relationships with our partners and facilitates the commercialization of our innovations. In addition, intellectual property protection helps us enhance our brand image and market competitiveness. Our firm developed a data security solution based on blockchain technology. After successfully applying for the relevant patents, we have not only been able to market this solution as an independent product but have also successfully attracted a number of financial institutions and large-scale firms as partners to jointly promote the application of this solution in a number of fields. This not only brings considerable economic benefits, but also further enhances our market position in the field of data security.

Table 4.35 Interviews with "Has intellectual property protection contributed to the commercialization of your firm's innovations? Can you provide examples?" (Cont.)

Interview	Review of key points
Respondents	
Interviewee 3	Intellectual property protection does play a crucial role in our firm in commercializing innovations. Market advantage from technology exclusivity: We had developed a new power saving technology and successfully applied for a patent. Thanks to the protection of the patent, we were able to offer this technology exclusively in the market and quickly gained customer acceptance and market share. Enhanced investor confidence: When investors see that our firm owns a large number of intellectual property rights, such as patents and trademarks, they will perceive our firm as having strong technological strength and innovation capabilities and thus be more willing to co-operate or invest with us. This increased confidence helps us to obtain more financial support and accelerate the commercialization of our innovations. Enhance brand image and competitiveness: our firm owns a series of trademarks and copyrights related to electrical technology. Such intellectual property protection not only makes our brand more unique and recognizable but also strengthens customers' trust and recognition of our products. Promoting technology cooperation and transfer: such cooperation and transfer helps our firm to obtain more technological resources and market opportunities and accelerates the commercialization process of our innovations.

Table 4.35 Interviews with "Has intellectual property protection contributed to the commercialization of your firm's innovations? Can you provide examples?" (Cont.)

Interview	Review of key points
Respondents	
Interviewee 4	Intellectual property protection undoubtedly contributes significantly to the commercialization of our firm's innovations. Innovations are legally protected. Take for example, we have recently developed an intelligent customer service system, which is capable of providing customers with more efficient and personalized service experience through advanced artificial intelligence technology. During the development process, we attached great importance to intellectual property protection and applied for relevant patents and software copyrights in a timely manner. This enabled us to face the competition confidently when we brought the system to the market and successfully attracted a large number of customers. Intellectual property protection has also helped our firm to build closer relationships with our partners in the commercialization process. This building of trust helps our firm to expand more business opportunities and achieve rapid commercialization of our innovations. Intellectual property protection also helps our firm's pricing and marketing strategies for our innovations. When our innovations are unique and exclusive, we can more confidently set higher prices and adopt more flexible marketing strategies to promote them. It helps our firm to better meet market demands and maximize the commercial value of our innovations.

Table 4.35 Interviews with "Has intellectual property protection contributed to the commercialization of your firm's innovations? Can you provide examples?" (Cont.)

Interview	Review of key points
Respondents	
Interviewee 5	Intellectual property protection undoubtedly plays an important role in promoting the commercialization of our firm's innovations. Intellectual property protection provides us with legal protection. An example is a specialty cuisine recently developed, which combines the essence of traditional Zigong Salt Cuisine with modern cooking techniques and has a unique taste that is very popular among consumers. We don't have to worry that our competitors will easily imitate our products because we have legal weapons to protect our innovations. This protection makes us more confident in the marketing process and dare to invest more resources in brand promotion and market expansion. As a matter of fact, intellectual property protection not only helps us protect our innovations but also brings us practical benefits in commercialization. By selling through online and offline channels, we have quickly opened up the market and achieved good sales results. At the same time, we have also cooperated with some well-known catering firms to introduce our specialties to a wider group of consumers.



Table 4.35 Interviews with "Has intellectual property protection contributed to the commercialization of your firm's innovations? Can you provide examples?" (Cont.)

Interview	Review of key points
Respondents	
Interviewee 6	Intellectual property protection has played a crucial role in facilitating the commercialization process of our firm's innovations. Firstly, intellectual property protection provides legal protection for our innovations. Our firm had successfully developed a new technology with market potential and applied for patent protection. Thanks to patent protection, we ensured the uniqueness and innovation of our technology, which attracted the attention of many potential partners. During the negotiation process with these partners, we successfully transferred the technology at a reasonable price and gained considerable financial returns by virtue of the patent protection. Secondly, intellectual property protection has also won our firm an advantage in market competition. In the field of intelligent hardware, our firm launched a smart bracelet with independent intellectual property rights. The bracelet adopts our unique algorithm and design to achieve a more accurate health monitoring function. By applying for patents and trademarks, we have ensured the uniqueness and innovation of our product and developed a good reputation in the market. This smart bracelet is not only loved by consumers but also brings considerable sales and market share to our firm. In addition, intellectual property protection also helps our firm to establish a stable cooperation relationship. This mode of cooperation helps our firm to expand its market, enhance its technological strength, and promote the commercialization of its innovations.

Table 4.35 Based on the results of the in-depth interviews, for the question "Has intellectual property protection contributed to the commercialization of your firm's innovations? Can you provide examples?" are summarized below:

All interviewees agreed that intellectual property protection has played an important role in the commercialization of innovations in their firms. They illustrated the importance and practical application of intellectual property protection in the commercialization of innovations through specific examples.

1. Brand building and maintenance: Intellectual property protection, such as trademark and patent applications, helps firms to build and maintain a unique brand image and enhance consumer awareness and trust in their products, thus promoting the commercialization of innovations.

2. Legal protection and trust building: Interviewees emphasized the role of legal protection of intellectual property protection, which reduces the risk of innovations being illegally copied or imitated and enhances the relationship of trust between firms and their partners, thus providing strong support for the commercialization of innovations.

3. Market access and competition strategy: intellectual property protection makes the firm's innovations more competitive in the market, which helps the firm to formulate effective market access and competition strategy and further promotes the commercialization of the innovations.

4. Attracting partners and investors: By displaying the firm's IPR achievements, the firm can attract more partners and investors to jointly promote the commercialization of its innovations.

5. Pricing and marketing strategies: Intellectual property protection makes a firm's innovations unique and exclusive, which helps the firm to develop higher pricing strategies and adopt more flexible marketing strategies to promote these innovations.

Specific examples include:

1. Smart home products integrating a number of innovative technologies. Through patent protection, it establishes co-operative relationships with a number of channel providers and partners to jointly promote the products and achieve good sales results.

2. Data security solutions based on blockchain technology, through patent protection, successfully attracted a number of financial institutions and large firms as partners to jointly promote the application of the solutions in a number of fields.

3. The new power energy saving technology is exclusively offered in the market through patent protection and quickly gained customer recognition and market share.

4. Specialty cuisine combines traditional and modern cooking techniques, and through intellectual property protection, it is more confident in the marketing process, successfully opening the market and achieving good sales results.

5. Intelligent bracelets with independent intellectual property rights have achieved more accurate health monitoring functions through unique algorithms and designs and adopted intellectual property protection strategies, winning a competitive advantage in the market.

These examples fully illustrate the importance and practical application effect of intellectual property protection in the commercialization of firm innovations.

4.8.11 Question 11 "What Problems Related to Intellectual Property Protection have you Encountered During the Commercialization of your Innovations? How were they Resolved?"

Table 4.36 Interviews with "What problems related to intellectual property protection have you encountered during the commercialization of your innovations? How were they resolved?"

Interview Respondents	Review of key points
Interviewee 1	The risk of intellectual property infringement has been strengthened by strengthening market monitoring and tracking and detecting infringement through professional intellectual property service providers. Difficulty in assessing the value of intellectual property, a professional intellectual property assessment agency has been introduced to provide objective and accurate assessment of the value of intellectual property through professional assessment methods and models. Insufficient IP management and operation capacity, the construction of IP management team has been strengthened and talents with rich experience and professional skills have been introduced. Challenges of intellectual property in the process of internationalization, we have strengthened the layout and planning of international intellectual property and protected the rights and interests of our innovations globally by applying for international patents and registering international trademarks.

Table 4.36 Interviews with "What problems related to intellectual property protection have you encountered during the commercialization of your innovations? How were they resolved?" (Cont.)

Interview	Review of key points
Respondents	
Interviewee 2	Problems: Risk of intellectual property infringement; high cost of intellectual property protection; complexity of transnational intellectual property protection. Solutions: Setting up a dedicated intellectual property protection team; cooperating with professional intellectual property service providers; optimising the input and return of intellectual property protection; strengthening the management and maintenance of intellectual property rights; strengthening the layout of cross-border intellectual property protection; strengthening the training of employees' awareness of intellectual property rights; setting up intellectual property rights incentive mechanisms; strengthening the communication and collaboration with partners.
Interviewee 3	Challenges: technology leakage risks; patent infringement disputes; brand protection difficulties. Solution: Strengthen internal management and confidentiality measures; establish a sound patent management system; strengthen brand protection and rights defence.

Table 4.36 Interviews with "What problems related to intellectual property protection have you encountered during the commercialization of your innovations? How were they resolved?" (Cont.)

Interview	Review of key points
Respondents	
Interviewee 4	Intellectual property rights have been infringed and we have taken legal action, including suing infringers and seeking damages. We have also strengthened our co-operation with law enforcement authorities and enhanced our internal training on intellectual property protection to ensure that our employees understand how to recognise and report infringements. The application cycle for intellectual property protection is long, and we have strengthened our co-operation with intellectual property agencies, seeking their professional guidance and assistance to ensure that our applications are accepted and examined more quickly. We also pay attention to policy developments in order to keep abreast of and adapt to new intellectual property protection policies. The scope of intellectual property protection is unclear. Before applying for intellectual property rights, we will conduct sufficient market research and technical analysis to determine the uniqueness and value of our innovations. We also hold in-depth discussions and consultations with intellectual property experts to ensure that our applications receive the broadest and most effective protection. Intellectual property protection in international collaborations We will fully understand the intellectual property protection policies and regulations of the target countries before we engage in international collaborations. At the same time, we will also fully communicate and consult with our partners to ensure that both parties reach a consensus on intellectual property protection.

Table 4.36 Interviews with "What problems related to intellectual property protection have you encountered during the commercialization of your innovations? How were they resolved?" (Cont.)

Interview	Review of key points
Respondents	
Interviewee 5	The emergence of counterfeit products and strengthening legal defence: we actively collect evidence, report to relevant law enforcement authorities and pursue the responsibility of counterfeiters through legal channels; enhancing product anti-counterfeiting ability: we add anti-counterfeiting marks on product packaging and popularise anti-counterfeiting knowledge to consumers through online and offline channels to improve their ability to identify counterfeiting. Long intellectual property rights application cycle, planning ahead: we start planning for intellectual property rights application at the early stage of R&D to ensure that we can submit the application quickly after the product development is completed; seeking professional support: we co-operate with professional intellectual property rights agents, who provide us with professional guidance and support to help us speed up the application progress. Insufficient awareness of intellectual property protection and strengthening publicity and education: we strengthen publicity and education on intellectual property protection through internal training, cooperation negotiations, consumer interaction and other means to raise the awareness of our partners and consumers on intellectual property protection; signing confidentiality agreements: we sign confidentiality agreements with our partners to clarify the responsibilities and obligations of both parties in terms of intellectual property protection and to prevent the disclosure of business secrets and the We sign confidentiality agreements with our partners to clarify the responsibilities and obligations of both parties in the protection of intellectual property rights, so as to prevent the leakage of business secrets and infringement of rights.

Table 4.36 Interviews with "What problems related to intellectual property protection have you encountered during the commercialization of your innovations? How were they resolved?" (Cont.)

Interview Respondents	Review of key points
Interviewee 6	Patent infringement issues strengthened market monitoring, timely detection and collection of evidence of infringement; actively cooperated with patent agencies to combat infringement through legal channels; strengthened communication with law enforcement agencies to obtain their support and assistance. Leakage of commercial secrets, we have established a strict confidentiality system and signed confidentiality agreements with all employees. At the same time, we strengthened the management of internal information security. Intellectual Property Valuation and Transaction Difficulties, a professional intellectual property valuation agency was hired to assess the market value of our innovations. Transnational intellectual property protection, we have strengthened our co-operation with overseas intellectual property agencies, actively applied for international patents and understood the intellectual property laws and regulations of different countries.

Table 4.36 Based on the results of the in-depth interviews, the answer to the question "What problems related to intellectual property protection have you encountered during the commercialization of your innovations? How were they resolved?" is summarized below:

Main problems encountered:

1. Risk of intellectual property infringement: Several interviewees mentioned the risk of intellectual property infringement, including patent infringement and brand counterfeiting.
2. High cost of intellectual property protection: Some interviewees believe that the high cost of filing, maintaining and managing intellectual property rights puts pressure on firms' finances.

3. Complexity of cross-border intellectual property protection: In the process of internationalization, differences in intellectual property laws and regulations in different countries lead to increased protection difficulties.

4. Difficulty in assessing the value of intellectual property rights: how to accurately assess the market value of intellectual property rights has become a challenge for firms.

5. Technology leakage and trade secret protection: how to ensure that innovative technologies are not leaked has become a concern for interviewees.

6. Long intellectual property rights application cycle: Some interviewees reflected that the intellectual property rights application process is time-consuming, which affects the commercialization process of innovative achievements.

7. Insufficient awareness of intellectual property protection: some interviewees believe that employees' and partners' awareness of intellectual property protection needs to be strengthened.

Solution:

1. Strengthen market monitoring and legal defense of rights: the interviewee has discovered and collected evidence of infringement in time by strengthening market monitoring and pursued the responsibility of infringers through legal channels.

2. Co-operate with professional organizations: Interviewees generally choose to co-operate with professional intellectual property service organizations to seek professional legal, assessment and management support.

3. Strengthening internal management and confidentiality measures: By establishing a strict confidentiality system and signing confidentiality agreements with employees, internal information security management is strengthened to prevent technology leakage.

4. Optimize inputs and returns: Optimize the inputs and returns of intellectual property protection to ensure that the firm achieves good economic benefits while protecting its innovations.

5. Strengthen international intellectual property protection: Protect the rights and interests of innovations globally by applying for international patents and registering international trademarks.

6. Intensify publicity, education and training: Raise the awareness of intellectual property protection among employees, partners and consumers through internal training, co-operation negotiation, consumer interaction and other means.

7. Advance planning and professional support: start planning for IPR application at the early stage of R&D and cooperate with professional IPR agencies to speed up the application progress.

To sum up, there are various intellectual property protection problems encountered by firms in the process of commercialization of their innovations. However, by strengthening market monitoring, cooperating with professional agencies, optimizing management, enhancing publicity, education and training, and in many other ways, firms can effectively solve these problems, protect their innovations and achieve good economic benefits.

Intellectual property protection provides us with legal protection. As an example, we have recently developed a specialty cuisine, which combines the essence of traditional Zigong salt dishes with modern cooking techniques, with a unique taste that is loved by consumers. We don't have to worry that our competitors will easily imitate our products because we have legal weapons to protect our innovations. This protection makes us more confident in the marketing process and dare to invest more resources in brand promotion and market expansion. As a matter of fact, intellectual property protection not only helps us protect our innovations but also brings us practical benefits in commercialization. By selling through online and offline channels, we have quickly opened up the market and achieved good sales results. At the same time, we have also cooperated with some well-known catering firms to introduce our specialties to a wider group of consumers.

4.8.12 Question 12 "Does Intellectual Property Protection help Firms Gain a Competitive Advantage in the Market? Can you Share some Practical Examples?"

Table 4.37 Interviews with "Does intellectual property protection help firms gain a competitive advantage in the market? Can you share some practical examples?"

Interview Respondents	Review of key points
Interviewee 1	Intellectual property protection does help firms gain a competitive edge in the marketplace. Technological innovation and patent protection. Our firm has invested a lot of R&D resources in the field of new energy and successfully developed a breakthrough in battery technology. To ensure the uniqueness and market advantage of this technology, we applied for patent protection in time. Due to patent protection, our competitors cannot easily copy or imitate this technology, thus enabling us to gain a clear competitive advantage in the new energy market. Brand building and trademark protection, we have successfully created a unique and influential brand image. Intellectual property co-operation and licensing, we will actively seek co-operation with other firms or research institutes and acquire the required technology through intellectual property licensing. We once cooperated with an internationally renowned technology firm and obtained the right to use one of its core technologies. The introduction of this technology has greatly enhanced the competitiveness of our products and enabled us to rapidly capture market opportunities.
Interviewee 2	Intellectual property protection does help firms gain a competitive edge in the marketplace. We have successfully developed an information technology product with unique features. In order to ensure the uniqueness and technological advantages of this product, we promptly applied for relevant patent and trademark protection. These intellectual property protections have enabled us to differentiate our product from our competitors' products in the marketplace with clear differentiating features. A well-known technology firm owns a large number of patents and core technologies in the field of artificial intelligence through continuous innovation and research and development. These intellectual property protections have enabled the firm to maintain its leading position in the market and successfully fend off imitations and plagiarism by competitors. How intellectual property protection helps firms gain a competitive advantage: Intellectual property protection can create technological barriers for firms to prevent competitors from copying or imitating their innovations. Trademark and copyright protection helps firms build and maintain their brand image. Intellectual property protection can incentivize firms to engage in continuous innovation and R&D and drive continuous improvement of products and services.

Table 4.37 Interviews with "Does intellectual property protection help firms gain a competitive advantage in the market? Can you share some practical examples?" (Cont.)

Interview Respondents	Review of key points
Interviewee 3	Intellectual property protection indeed plays a key role in giving firms a competitive edge in the marketplace. First, intellectual property protection ensures that our firm's technological innovations are not easily imitated or copied by others. Secondly, intellectual property protection also helps our firms to build a strong brand image. In addition, intellectual property protection helps our firms to cooperate and compete internationally. A competitor tried to imitate our electrical control system and sell similar products in the market. We discovered it in time and took legal measures to successfully defend our intellectual property rights through court proceedings.
Interviewee 4	Intellectual property protection does play a crucial role in giving firms a competitive edge in the marketplace. Firstly, intellectual property protection ensures the uniqueness and exclusivity of our innovations. Secondly, intellectual property protection enhances the brand image and reputation of the firm. Our firm has developed an intelligent customer service system, which is capable of providing customers with a more efficient and personalized service experience through natural language processing technology. During the R&D process, we applied for relevant patents and software copyrights in a timely manner. Our firm also possesses unique data analysis technology that provides customers with in-depth business insights and decision support. To ensure the exclusivity of this technology, we applied for patent protection in a timely manner. We have successfully applied this technology to a wide range of industries, bringing significant business value to the firm.

Table 4.37 Interviews with "Does intellectual property protection help firms gain a competitive advantage in the market? Can you share some practical examples?" (Cont.)

Interview Respondents	Review of key points
Interviewee 5	Intellectual property protection does help firms gain a competitive edge in the market. Firstly, through patent protection, our firm is able to ensure that the unique recipes and cooking processes of our specialty cuisines are not easily imitated by our competitors. This gives our products a unique position in the market. This uniqueness not only attracts a large number of consumers but also helps us establish a high-quality and innovative brand image. Secondly, trademark protection also plays a key role in maintaining our brand image and preventing infringement. This not only protects our brand image but also enhances consumer trust and loyalty to our products. In addition, intellectual property protection helps us establish a fair competitive market environment. This level playing field promotes innovative investment and technological advancement by firms, thereby enhancing the competitiveness and development of the industry as a whole. Some high-end catering firms have also applied for patents and registered trademarks to protect their unique dishes and brand image, thereby standing out in the face of fierce market competition.
Interviewee 6	Intellectual property protection undoubtedly plays a significant role in giving firms a competitive advantage in the marketplace. Firstly, intellectual property protection ensures the uniqueness and innovation of our technological achievements. This uniqueness makes our products and technologies more recognizable and competitive in the marketplace. Secondly, intellectual property protection helps us build brand reputation and credibility. Such brand reputation and credibility can attract more consumers and partners, thus further enhancing the market competitiveness of the firm. We have successfully developed a new material with unique functions and applied for patent protection. Many competitors try to imitate our products, but they are unable to directly copy our technology due to our patent protection. This has enabled our products to maintain a leading position in the market and has brought us considerable sales. Our firm has a well-known trademarked brand. This gives our brand a higher visibility and reputation in the market and attracts more consumers to choose our products. We have a technical co-operation with an internationally renowned firm to develop new technology. This has enabled us to gain more security and profit distribution rights in technical co-operation, further enhancing the market competitiveness of our firm.

Table 4.37 From the results of the in-depth interviews, all the interviewees unanimously agreed that intellectual property protection has a positive effect on firms' ability to gain competitive advantage in the market. The following is a summary and practical case sharing for this issue:

First, the importance of intellectual property protection.

1. Establishment of technological barriers: Through patent protection, firms can ensure the uniqueness of their technological innovations and prevent imitation and copying by competitors, thus establishing technological barriers in the market and enhancing competitive advantages.

2. Establishment and maintenance of brand image: Trademark and copyright protection helps firms to establish and maintain their brand image and enhance brand value and market influence.

3. Incentives for continuous innovation: intellectual property protection can incentivize firms to carry out continuous innovation and R&D, and promote the continuous improvement of products and services, so as to maintain market competitiveness.

Secondly, practical case sharing.

1. Interviewee 1: Firms in the field of new energy ensure their market advantage through patent protection of their breakthrough battery technologies; introduce core technologies to enhance product competitiveness through intellectual property cooperation and licensing.

2. Interviewee 2: Information technology firms protect their unique products through patents and trademarks to achieve market differentiation; well-known technology firms maintain their leading position in the field of artificial intelligence through extensive patent protection.

3. Interviewee 3: Electrical control system firms use intellectual property protection to ensure that their technological innovations are not imitated, to build their brand image, and to successfully defend their intellectual property rights against market losses.

4. Interviewee 4: Firms protect intelligent customer service systems and data analysis technologies through patents and software copyrights to improve service efficiency and business value and enhance market competitiveness.

5. Interviewee 5: Catering firms protect unique recipes and cooking techniques of speciality cuisines through patents to establish a high-quality brand image; maintain brand image and prevent infringement through trademark protection.

6. Interviewee 6: Material research and development firms protect their new materials with unique functions through patents to maintain their leading position in the market; enhance brand awareness and reputation through trademark protection to attract more consumers.

Finally, conclusion.

Intellectual property protection is crucial for firms to gain competitive advantage in the market. It not only helps firms to establish technical barriers and brand image but also motivates firms to innovate continuously and resist imitation and plagiarism by competitors. By strengthening intellectual property protection, firms can better protect their innovations, enhance market competitiveness and achieve sustainable development.

4.8.13 Question 13 "What do you Expect from Future Intellectual Property Protection Policies? In what Areas would you Like to see the Policy Improve?"

Table 4.38 Interviews with "What do you expect from future intellectual property protection policies? In what areas would you like to see the policy improve?"

Interview Respondents	Review of key points
Interviewee 1	Enhancing law enforcement; improving laws and regulations; strengthening international cooperation; simplifying the application process; and promoting the transformation and application of intellectual property rights. In short, I hope that future intellectual property protection policies will be more complete, effective and responsive to the development needs of the times, providing better protection and support for innovators and promoting scientific and technological innovation and sustainable economic and social development.
Interviewee 2	Enhancing policy unity and consistency; improving the strength and efficiency of protection; promoting the transformation and application of intellectual property; strengthening intellectual property education and training; enhancing international cooperation and exchanges; adapting to the development of new technologies and industries; and balancing public and private interests. Through the above improvements, the future intellectual property protection policy will be able to better adapt to the development needs of new technologies and industries, improve the strength and efficiency of protection, promote the transformation and application of intellectual property rights, facilitate the combination of innovative achievements with market demand, and realize the commercial and social value of intellectual property rights.
Interviewee 3	Strengthening protection and raising the cost of infringement; optimizing the examination process and improving the efficiency of examination; strengthening international cooperation and promoting global protection; promoting technological transformation and strengthening cooperation between industries, universities and research institutes; and raising public awareness and creating a favorable atmosphere. All in all, I expect that the future intellectual property protection policy will be more perfect, effective and fair, providing a strong guarantee for the innovative development of firms and the scientific and technological progress of the society.

Table 4.38 Interviews with "What do you expect from future intellectual property protection policies? In what areas would you like to see the policy improve?" (Cont.)

Interview Respondents	Review of key points
Interviewee 4	Strengthening enforcement efforts and efficiency; simplifying the application process; increasing support for small and medium-sized enterprises (SMEs); strengthening international co-operation; raising public awareness; flexibly adjusting the scope of protection; establishing a rapid response mechanism; and encouraging technological innovation and reasonable competition. In short, I expect that the future intellectual property protection policy will be more perfect, efficient and flexible to better protect the innovative achievements and legitimate rights and interests of firms and to promote the sustained and healthy development of the economy.
Interviewee 5	Firstly, I hope that the policy will further intensify the crackdown on infringement. Secondly, I hope that the policy will optimize the process and time for IPR applications. In addition, I also hope that the policy will strengthen support for intellectual property protection for small and medium-sized enterprises (SMEs). Finally, I hope the policy will strengthen international co-operation and promote the unification and development of global intellectual property protection.
Interviewee 6	Strengthening enforcement efforts and efficiency; improving the legal system; enhancing training and publicity; establishing incentive mechanisms; strengthening international cooperation; and establishing a rapid response mechanism. In short, I hope that the future policy on intellectual property protection will be better and more powerful, providing innovators with more solid legal protection and promoting the sustained development of China's scientific and technological innovation endeavors.

Table 4.38 According to the results of the in-depth interviews, the interviewee has put forward various expectations and suggestions for the future intellectual property protection policy, mainly focusing on the following aspects:

1. Strengthening Enforcement Efforts and Efficiency

A number of interviewees emphasized the importance of enforcement efforts and efficiency. They hope that the future policy can further increase the strength of the

crackdown on infringement and improve the efficiency of law enforcement to ensure that intellectual property protection is effectively and efficiently protected.

2. Improvement of Laws and Regulations

Interviewers generally called for the improvement of laws and regulations on intellectual property protection, including the enhancement of policy unity and consistency, the improvement of protection strength and efficiency, and the flexible adjustment of the scope of protection. They hope that future laws will be more responsive to the development needs of new technologies and industries and provide better protection and support for innovators.

3. Optimizing the Examination Process and Improving Examination Efficiency

Some interviewees mentioned the importance of optimizing the examination process and improving the efficiency of examination of IPR applications. They hoped that the policy could simplify the application process and shorten the examination time, so as to reduce the time and economic costs for innovators.

4. Strengthening International Co-operation

Several interviewees emphasized the important role of international cooperation in intellectual property protection. They hoped that the policy could strengthen cooperation and exchanges with other countries and regions and promote the unification and development of global intellectual property protection.

5. Promoting the Transformation and Application of Intellectual Property Rights

Interviewees generally agreed that the transformation and application of intellectual property is crucial to realizing its commercial and social value. They hoped that policies could further promote the transformation and application of intellectual property rights and facilitate the integration of innovations with market demands.

6. Strengthening intellectual property rights education and training

Some interviewees also mentioned the importance of strengthening IP education and training. They believed that raising public awareness and understanding of intellectual property rights would help create a favorable atmosphere for respecting and protecting intellectual property rights.

7. Support for Small and Medium-sized Enterprises (SMEs)

Some interviewees specifically mentioned support for intellectual property protection for SMEs. They hoped that policies would increase support for SMEs to help them better cope with IP challenges.

8. Establishment of Rapid Response Mechanism

Some interviewees suggested the establishment of a rapid response mechanism so as to respond to incidents of intellectual property protection in a timely manner and to protect the legitimate rights and interests of innovators.

9. Encourage technological innovation and reasonable competition

Finally, the interviewees generally hope that the policy can encourage technological innovation and reasonable competition and promote technological innovation and sustainable economic and social development.

In summary, the expectations of the interviewees for future intellectual property protection policies focus on strengthening enforcement efforts and efficiency, improving laws and regulations, optimizing the examination process, strengthening international cooperation, promoting the transformation and application of intellectual property rights, strengthening intellectual property education and training, supporting small and medium-sized enterprises (SMEs), setting up a rapid response mechanism, and encouraging technological innovation and reasonable competition. These recommendations will help promote the continuous improvement and development of intellectual property protection policies, provide better protection and support for innovators, and promote scientific and technological innovation and sustain economic and social development.

4.8.14 Question 14 "With the Development of Science and Technology and the Advancement of Globalization, what new Challenges and Opportunities will Intellectual Property Protection Face?"

Table 4.39 Interviews with "With the development of science and technology and the advancement of globalization, what new challenges and opportunities will intellectual property protection face?"

Interview Respondents	Review of key points
Interviewee 1	Challenges: rapid technological iteration; diversified and hidden means of infringement; cross-border infringement; challenges posed by artificial intelligence and big data. Opportunities: technological innovation drives IP development; international cooperation is strengthened; IP service industry develops; policy environment is optimized.
Interviewee 2	Challenges: Increased technological complexity; transnational infringement issues; challenges in cyberspace; challenges of data privacy and security. Opportunities: Increased international cooperation; application of new technologies; accelerated transformation of intellectual property rights; expanded market for intellectual property services.
Interviewee 3	Challenges: diversification and sophistication of infringement methods; intensification of transnational infringement; and new challenges posed by technological development. Opportunities: strengthening international cooperation and exchanges; promoting the innovation and application of intellectual property; and promoting the prosperity and development of the intellectual property market.
Interviewee 4	Challenges: the complexity brought about by technological innovation; legal differences brought about by globalization; and the hidden and transnational nature of intellectual property infringement. Opportunities: international cooperation and improvement of the legal system; development and application of technological means; and growth of market demand.

Table 4.39 Interviews with "With the development of science and technology and the advancement of globalization, what new challenges and opportunities will intellectual property protection face?" (Cont.)

Interview Respondents	Review of key points
Interviewee 5	On the challenge side, infringement of intellectual property rights has become more insidious, rapid and widespread, making it extremely difficult for us to defend our rights. At the same time, globalization has exacerbated the transnational flow of intellectual property and the difficulty of intellectual property protection, and we need to face the risks and challenges of infringement from all parts of the globe. Opportunities exist as well. The development of technology provides new means and methods for intellectual property protection. Blockchain technology can also provide secure, transparent and traceable guarantees for IP rights enforcement, documentation and transactions. Specifically, we can take the following measures to deal with these challenges and grasp the opportunities: Strengthen training on intellectual property awareness and raise employees' awareness of and attention to intellectual property protection. Establishing a comprehensive IP management system, including standardized processes for application, review, monitoring, rights protection and other aspects. Use technological means to improve the efficiency of rights protection, such as adopting artificial intelligence, big data and other technological means to monitor and identify infringement. Strengthening cooperation and exchanges with the international community to jointly promote the unity and development of global intellectual property protection.
Interviewee 6	Challenges: rapid technological iteration and increased complexity; increased transnational infringement; infringement under the Internet and digital economy. Opportunities: increased international cooperation and exchanges; advances in technological means; and improvement of the legal system.

Table 4.39 Challenges and opportunities for intellectual property protection in the context of scientific and technological development and globalization, based on in-depth interviews:

In terms of challenges

1. Rapid technological iteration and increased complexity: With the rapid development of science and technology, the objects of intellectual property protection, such as technologies, products and services, are faced with rapid updating and increased complexity. This requires that intellectual property protection policies and technical means must keep abreast of the times in order to cope with the ever-changing challenges.

2. Diversified and hidden means of infringement: With the development of technology, intellectual property infringement has become more hidden and diversified, such as network infringement, cross-border infringement, etc., which brings great difficulties to the work of rights protection.

3. Intensification of transnational infringement problems: In the context of globalization, the transnational flow and protection of intellectual property protection has become more difficult. The infringement problems of transnational corporations, especially the infringement behavior of transnational e-commerce platforms, have brought new challenges to intellectual property protection.

4. Infringement problems under the Internet and digital economy: The rapid development of the Internet and digital economy has provided broader space and means for intellectual property infringement, such as online piracy and illegal downloading.

5. Challenges of data privacy and security: In the era of big data and artificial intelligence, the issue of data privacy and security has become a new challenge for intellectual property protection. How to protect intellectual property protection data from illegal access and utilization is an urgent issue.

In terms of opportunities

1. Technological innovation drives the development of intellectual property: the development of science and technology provides new means and methods for intellectual property protection, such as blockchain technology, artificial intelligence and big data technology, which can improve the efficiency and quality of intellectual property protection.

2. Strengthening of international cooperation and exchange: in the context of globalization, international cooperation and exchange are of great significance to

intellectual property protection. Strengthening cooperation and exchange with the international community can jointly promote the unity and development of global intellectual property protection.

3. Development of Intellectual Property Service Industry: With the increased attention to intellectual property protection, the intellectual property service industry has also developed rapidly. This provides more professional support and services for intellectual property protection, management and operation.

4. Optimization of policy environment: The government's attention to intellectual property protection has been increasing, and the policy environment has been optimized. This provides better institutional guarantee and support for intellectual property protection and development.

5. Growing Market Demand: With the development of the economy and the improvement of consumers' awareness of intellectual property rights, the market demand for intellectual property rights is growing. This provides a broader market space for the transformation and application of intellectual property rights.

In order to meet these challenges and grasp the opportunities, the following measures can be taken:

1. Strengthen the training intellectual property awareness and improve employees' knowledge of and attention to intellectual property protection.

2. Establishing a perfect intellectual property management system, including standardized processes for all aspects of application, review, monitoring and rights protection.

3. Use scientific and technological means to improve the efficiency of rights protection, such as adopting artificial intelligence, big data and other technological means to monitor and identify infringement.

4. Strengthening co-operation and exchanges with the international community to jointly promote the unity and development of global intellectual property protection.

5. Pay attention to the development of new technologies and adjust and improve intellectual property protection policies and means in a timely manner.

4.8.15 Question 15 "How do you Think Firms Should Address these Challenges and Opportunities to Better Drive Innovation?"

Table 4.40 Interviews with "How do you think firms should address these challenges and opportunities to better drive innovation?"

Interview Respondents	Review of key points
Interviewee 1	Responding to challenges: enhancing intellectual property awareness; establishing a sound intellectual property management system; using technological means to strengthen protection; strengthening international cooperation; and establishing a rapid response mechanism. Grasping opportunities: actively investing in R&D; strengthening intellectual property operations; expanding intellectual property services; integrating into global innovation networks; and taking advantage of policy advantages. In short, firms should actively respond to the challenges and opportunities of intellectual property protection brought about by the development of science and technology and globalization, strengthen their intellectual property protection and operation, and improve their capability of independent innovation, so as to provide a strong support for the development of the firms.
Interviewee 2	I think our firms should respond in the following areas to better promote innovation: strengthening technology R&D and innovation; intellectual property protection; expanding international markets; and optimizing internal management. In the face of the challenges and opportunities brought about by technological development and globalization, we will adhere to the innovation-driven development strategy, strengthen technological research and development and innovation, intellectual property protection, expanding international markets and optimizing internal management in order to better promote innovation and development of our firms.

Table 4.40 Interviews with "How do you think firms should address these challenges and opportunities to better drive innovation?" (Cont.)

Interview Respondents	Review of key points
Interviewee 3	In the face of intellectual property challenges and opportunities brought about by scientific and technological development and globalization, firms can cope with them in the following ways to better promote innovation: strengthening the awareness of intellectual property protection and system construction. Actively using scientific and technological means to enhance intellectual property protection capabilities; strengthening international cooperation to jointly deal with transnational infringement; promoting innovation and application of intellectual property rights; strengthening the construction and operation of intellectual property markets; and building an intellectual property risk management system. The key for firms to cope with the challenges and opportunities of intellectual property protection lies in strengthening the awareness of intellectual property protection and system construction, actively applying scientific and technological means to enhance the protection capacity, strengthening international cooperation to jointly deal with transnational infringement, promoting innovation and application of intellectual property rights, strengthening the construction and operation of intellectual property rights market and building intellectual property rights risk management system. Through the implementation of these measures, firms can better protect their innovative achievements, promote the in-depth development of innovative activities, and inject a steady stream of power into their development.

Table 4.40 Interviews with "How do you Think Firms Should Address these Challenges and Opportunities to Better Drive Innovation?" (Cont.)

Interview Respondents	Review of key points
Interviewee 4	Strategies to cope with challenges: Strengthening internal awareness of intellectual property protection; establishing a professional intellectual property management team; strengthening cross-border co-operation and communication; and using technological means to strengthen monitoring and rights protection. Strategies for seizing opportunities: actively participate in international cooperation and competition; use technological means to promote innovation; pay attention to market demands and changes; and strengthen IPR operation and management. In the face of challenges and opportunities of intellectual property protection brought about by technological development and globalization, firms should actively respond to the challenges and grasp the opportunities, and improve their intellectual property protection capacity through strengthening internal management, establishing professional teams, enhancing cross-border cooperation and communication, and applying technological means to strengthen monitoring and right enforcement, so as to promote sustainable innovation and development of the firms.
Interviewee 5	Facing challenges: increasing awareness of intellectual property protection; establishing a sound protection system; increasing investment in R&D; strengthening technical precautions; and focusing on cooperation and negotiation when expanding into international markets. Grasp the opportunities: improve the efficiency of intellectual property protection by using scientific and technological means; expand the commercial application of intellectual property; strengthen cooperation with international organizations; encourage employees to innovate; cross-border cooperation and resource integration. Faced with the challenges and opportunities of intellectual property protection, firms should respond positively and act proactively to promote innovation by strengthening intellectual property protection, increasing investment in research and development, and using scientific and technological means to improve the efficiency of protection, so as to inject new vitality into the development of firms.

Table 4.40 Interviews with "How do you think firms should address these challenges and opportunities to better drive innovation?" (Cont.)

Interview Respondents	Review of key points
Interviewee 6	Addressing challenges: enhancing awareness of intellectual property protection; strengthening technological research and development and protection; establishing cross-border cooperation and rights protection mechanisms; and using technological means to strengthen protection. Grasp the opportunities: strengthen international cooperation and exchanges; take advantage of policies to promote innovation; strengthen intellectual property protection operation; and cultivate intellectual property protection talents. Faced with the challenges and opportunities of intellectual property protection, firms should respond positively and act proactively to promote innovation and development of enterprises by strengthening technological R&D and protection, establishing transnational cooperation and rights protection mechanisms, using technological means to strengthen protection, and enhancing international cooperation and exchanges.

Table 4.40 Based on the results of the in-depth interviews, firms should adopt the following strategies to better promote innovation in the face of the challenges and opportunities of intellectual property protection brought about by technological development and globalization:

In terms of addressing the challenges

1. Enhance the awareness of intellectual property: firms need to strengthen the awareness of and attach importance to intellectual property protection among their internal staff and enhance the awareness of intellectual property protection among all staff through training and education.

2. Establishment of a sound intellectual property management system: Establish a sound intellectual property management system, including standardized processes for application, review, monitoring, rights protection and other aspects, to ensure that firms' intellectual property rights are effectively managed.

3. Strengthen intellectual property protection by technological means: Actively use technological means, such as artificial intelligence, big data, blockchain, etc., to improve intellectual property protection capability and strengthen monitoring and identification of infringement.

4. Strengthen international cooperation: In the face of transnational infringement, firms need to strengthen cooperation and communication with the international community to jointly meet the challenges of global intellectual property protection.

5. Increase investment in R&D: Increase investment in R&D and innovation, improve the ability of independent innovation, and fundamentally enhance the competitiveness of firms' intellectual property rights.

6. Strengthen technical precautionary measures: Strengthen internal technical precautionary measures of the firm to prevent technology leakage and infringement.

7. Focus on co-operation and negotiation when expanding international markets: when expanding international markets, focus on co-operation and negotiation with local firms and organizations to ensure reasonable intellectual property protection.

Grasp opportunities

1. Actively participate in international cooperation and competition: Take advantage of the opportunities of globalization and actively participate in international cooperation and competition to enhance the competitiveness of firms in the international market.

2. Use scientific and technological means to promote innovation: Use scientific and technological means to promote the innovation activities of firms and improve the efficiency and quality of innovation.

3. Paying attention to market demand and changes: Paying close attention to market demand and changes, adjusting the innovation strategy and direction in time to ensure that the innovation results meet the market demand.

4. Strengthen intellectual property operation: strengthen the operation and management of intellectual property, promote the commercial application of intellectual property, and maximize the value of intellectual property.

5. Cultivate intellectual property talents: Strengthen the cultivation and introduction of intellectual property talents, establish a professional intellectual property management team, and provide strong support for firms' intellectual property protection.

6. Use policy advantages to promote innovation: make full use of policy advantages, such as tax incentives, financial support, etc., to promote innovation activities of firms.

7. Cross-border co-operation and resource integration: actively carry out cross-border co-operation and resource integration and form a synergy with other firms and organizations to jointly promote intellectual property protection and application.

In conclusion, in the face of the challenges and opportunities of intellectual property protection brought about by the development of science and technology and globalization, firms should respond positively and act proactively to promote innovation and inject new vitality into the development of firms by strengthening intellectual property protection, increasing investment in research and development, and using scientific and technological means to improve the efficiency of protection, and other measures.

4.8.16 Summary of In-depth Interviews

This study delves into the intricate relationship between intellectual property protection (IPP) and firm innovation outputs, drawing insights from in-depth interviews (Tables 4.26 to 4.40) and incorporating theoretical hypotheses (H1-H3) to enhance academic rigor. H1 posits an inverted U-shaped relationship between IPP and firm innovation outputs, implying optimal levels beyond which IPP may stifle innovation. H2 and H3 propose technological innovation and R&D capability, respectively, as mediating mechanisms in this relationship.

1. IPP Achievements and Challenges

Current IPP policies have notably promoted technological innovation and safeguarded innovation fruits. However, challenges persist, necessitating a focus on enforcement strengthening, regulatory optimization, examination streamlining, infringement combat, emerging area protection, and cross-border cooperation enhancement. Firms recognize IPP's importance, implementing comprehensive systems that safeguard innovation safety and returns, fostering industry progress.

2. IPP and Firm Innovation Ability (Supporting H1)

A positive correlation exists between IPP and firm innovation ability, as evidenced by case analyses highlighting IPP's role in stimulating innovation enthusiasm, technological advantage formation, innovation efficiency enhancement, a secure innovation environment creation, and international market access. However, the inverted U-shaped relationship (H1) implies that excessive IPP may hinder flexibility and creativity, necessitating a delicate balance.

3. IPP, Technological Innovation, and R&D Capability (Mediation Hypotheses H2 & H3)

The strategic alignment of IPP with technological innovation is crucial for sustainable innovation and competitiveness. By integrating IPP into R&D processes, fostering employee awareness, emphasizing transformation and application, and enhancing external collaborations, firms maximize IPP's positive influence on innovation depth. R&D capability, as a mediator (H3), bolsters firms' R&D motivation, ensures investment returns, promotes collaboration, enhances competitiveness, and fosters an innovative culture.

4. IPP in Commercialization and Market Competitiveness

IPP significantly impacts firms' R&D capabilities, driving motivation, securing investments, facilitating cooperation, and nurturing an innovative ethos. In commercialization, IPP ensures market competitiveness and economic gains, reflecting firms' intellectual property management prowess. Addressing challenges through market monitoring, professional collaboration, management optimization, and education underscores IPP's strategic value.

5. Policy Implications and Future Directions

Interviewees' aspirations for IPP policies underscore the need for enhancement enforcement, legal improvements, process optimization, international cooperation, IP transformation, education expansion, SME support, and a responsive mechanism. These recommendations align with promoting IPP's continuous improvement, safeguarding innovators, and fostering technological advancement and sustainable socio-economic growth.

Amidst the technological and globalization dynamics, firms must balance IPP's dual-edged sword effect, optimizing protection levels to nurture innovation without stifling creativity (H1). Technological innovation and R&D capability emerge as pivotal mediators (H2, H3), emphasizing the need for strategic IPP integration. Concurrently, societal and governmental efforts to refine IPP systems underpin the vitality of innovation, economic growth, and societal progress.



CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the findings on the effect of intellectual property protection on firm innovation in Sichuan Province, as well as discusses the consistency of the research questions and hypotheses on the effect of intellectual property protection on firm innovation in Sichuan Province, followed by the theoretical contributions and practical implications of the next section. Finally, the limitations of this study and the implications for further research are identified.

5.1 Conclusions

In order to investigate the impact of intellectual property protection on firm innovation in Sichuan Province and to explain this impact by considering both intra-firm innovation and firm innovation outputs, this study adopts a mixed research methodology, including quantitative and qualitative analyses. In the study, the impact of intellectual property protection on firm innovation outputs is explored in depth. By employing the Partial Least Squares Structural Equation Modeling (PLS-SEM) method, SPSS curve regression was also used. We find that intellectual property protection positively affects firm innovation outputs to a certain extent, and after this interval, intellectual property protection also negatively affects firm innovation outputs to a certain extent. Specifically, a good intellectual property protection system helps stimulate firms' innovation motivation and investment, which in turn encourages firms to invest more in technological innovation, while an excessive intellectual property protection system is detrimental to firm innovation outputs. In addition, our findings suggest that intellectual property protection also helps to enhance firms' competitiveness and market position, which further strengthens firms' demand for and awareness of intellectual property protection. Through in-depth analyses of the data, we also identified some key indicators related to intellectual property protection, such as the construct score and Cronbach's alpha coefficient, which are important for assessing the quality and reliability of firm innovation outputs.

However, we also noted some discrepancies in the results of the studies and possible limitations in the analysis of the data. For example, there may be some differences in the results obtained when different hypotheses are analysed individually versus when they are considered together, which may stem from factors such as interaction effects or covariances that are not accounted for in the model. In addition, when assessing model fit and validity, we also need to take into account the impact of factors such as sample size, model setting, and statistical power on the results.

Despite some limitations, our findings still suggest that intellectual property protection has a significant impact on firm innovation outputs. Future research could further explore the responses of different industries and regions to intellectual property protection and its impact on innovation activities to provide a deeper understanding and practical recommendations.

The theoretical background and findings of this study are explored next to further understand and address the research questions posed in this research.

Three main research questions were raised earlier in this study:

RQ1: What impact does firm intellectual property protection have on firm innovation outputs?

RQ2: Does technological innovation mediate the relationship between intellectual property protection and firm innovation outputs?

RQ3: Does R&D capability mediate the relationship between intellectual property protection and firm innovation outputs?

In order to determine the answers to the above research questions, the three proposed hypotheses were examined and tested and the answers are as follows:

Table 5.1 Summary of results of all hypothesis tests

Research Questions	Hypotheses	Conclusion	Result
RQ1:What impact does firm intellectual property protection have on firm innovation outputs?	H1	Hypotheses 1 are supported.	Supported
RQ2: Does technological innovation mediate the relationship between intellectual property protection and firm innovation outputs?	H2	Hypotheses 2 are supported.	Supported
RQ3: Does R&D capability mediate the relationship between intellectual property protection and firm innovation outputs?	H3	Hypotheses 3 are supported.	Supported

H1: Intellectual property protection and firm innovation outputs are related and have an inverted U-shaped relationship.

H2: Technological innovation mediates the relationship between intellectual property protection and firm innovation outputs.

H3: R&D Capability mediates the relationship between intellectual property protection and firm innovation outputs.

5.2 Discussion

5.2.1 Discussion of Research Question 1: What Impact does Firm Intellectual Property Protection have on Firm Innovation Outputs?

Hypothesis H1 Testing

H1: Intellectual property protection and firm innovation outputs are related and have an inverted U-shaped relationship.

Drawing upon the extant scholarly literature, we engage in a rigorous examination of the ramifications of intellectual property protection (IPP) on corporate innovative outputs. Intriguingly, our analysis challenges the prevailing notion of a straightforward positive influence, revealing instead a potentially nonlinear, inverted U-shaped dynamic between IPP and firm-level innovation outcomes.

Initially, the work of Dai, & Sun, (2021) underscores the pivotal role of robust IPP systems in fostering innovation incentives among firms and enhancing their technological prowess and resulting innovative outputs. This alignment with prior research underscores the generally positive influence of IPP on corporate innovation.

However, Dai's (2014) investigation delves deeper, illuminating how heightened IPP fosters the sophistication of exported products across Chinese provinces, implying that it may incentivize firms to embark on more intricate and innovative product development endeavors, thereby augmenting innovation outputs.

Chung's (2021) contribution further nuances this discourse, positing that while effective IPP is conducive to economic growth, excessive protection may curtail firms' innovative endeavors, ultimately dampening the expansion of innovation outputs. This observation underscores the existence of an inverted U-shaped relationship between IPP and firm innovation outputs, signifying that while moderate protection can bolster innovation, overprotection may exert a detrimental effect.

Hence, our discourse underscores the significance of IPP in shaping firm innovation outputs while emphasizing the intricacies of a potentially nonlinear relationship therein. Future scholarly endeavors ought to delve deeper into the underpinnings of this inverted U-shaped dynamic, aiming to devise more refined IPP policies that optimally foster corporate innovation and economic advancement.

5.2.2 Discussion of Research Question 2: Does Technological Innovation Mediate the Relationship between Intellectual Property Protection and Firm Innovation Outputs?

Hypothesis H2 Testing

H2: Technological innovation mediates the relationship between intellectual property protection and firm innovation outputs.

Research has demonstrated the positive contribution of IPP to technological innovation, which subsequently exerts a substantial influence on firms' innovative outputs. Fan, & Zhou, (2012) underscore the pivotal role of technological innovation in enhancing efficiency across Chinese provinces, thereby emphasizing its criticality for economic progression. In this framework, IPP acts as a catalyst, motivating enterprises to

undertake heightened technological innovation endeavors, ultimately enhancing the efficacy and sophistication of such innovations.

Conversely, Hu's (2022) investigation highlights the pivotal influence of IPP on corporate behavior amidst trade liberalization. Effective IP safeguards encourage firms to augment their investments in technological innovation, leading to an elevation in the quality and quantity of innovation outputs. Furthermore, the analysis by Li, (2020) reveals a strong correlation between the rigor of IPP and the degree of economic development, suggesting that IPP is instrumental in fostering technological innovation and economic growth.

In conclusion, IPP exerts a vital impact on firms' innovative outputs by fostering technological advancement. A robust IPP system spurs firms into intensifying their technological innovation activities, refining innovation efficiency and standards, and thereby fostering the expansion of firms' innovative outputs. This revelation holds profound theoretical and practical implications for the design and refinement of IPP policies aimed at bolstering corporate innovation and advancing economic development.

5.2.3 Discussion of Research Question 3: Does R&D Capability Mediate the Relationship between Intellectual Property Protection and Firm Innovation Outputs?

Hypothesis H3 Testing

H3: R&D Capability mediates the relationship between intellectual property protection and firm innovation outputs.

The research underscores the positive contribution of IPP to firms' research and development (R&D) capabilities, which subsequently exerts a notable influence on their innovative outputs.

Firstly, Cao's (2021) investigation underscores the substantial impact of environmental scanning on the new product development performance of high-tech enterprises. Environmental scanning emerges as a crucial aspect of technological innovation for firms, and robust IPP fosters a stable innovation landscape and market security, thereby incentivizing firms to engage in environmental scanning and R&D endeavors.

Secondly, the analysis by Guan, (2016) reveals that the structure of cooperation networks influences national-level R&D efficiency. An effective IPP framework promotes collaboration and information exchange among firms, leading to enhanced R&D efficiency.

Furthermore, Hashimoto, & Haneda's (2018) study observes a shift in R&D efficiency within the Japanese pharmaceutical sector, suggesting that IPP may have been instrumental in augmenting firm innovation outputs by refining R&D efficiency and standards.

Additionally, Ji, & Zhang's (2023) findings emphasize the significant impact of R&D investment on firm performance. IPP offers a stable innovation environment and legal safeguards, motivating firms to escalate their R&D investments, thereby bolstering R&D capabilities and the quality of innovative outputs.

Collectively, IPP significantly influences firm innovation outputs by bolstering R&D capabilities. An effective IPP system establishes a stable innovation environment and market security, encourages firms to augment R&D investments, and enhances R&D efficiency and standards, ultimately fostering the expansion of firm innovation outputs. This revolution carries profound theoretical and practical implications for the development and refinement of IPP policies aimed at promoting corporate innovation and economic growth.

These findings underscore the significance of internal firm innovation capabilities in fostering sustained innovation and market competitiveness. Consequently, both firms and governments should prioritize the synergies between internal and external factors when devising strategies and policies to promote comprehensive and sustainable innovative development.

5.3 Contributions of the Study

5.3.1 Theoretical Contributions

Delving into the Inverted U-Shaped Relationship:

This research offers a sophisticated and nuanced theoretical augmentation to the prevailing scholarly corpus pertaining to intellectual property protection (IPP) and its

consequences on innovation productivity. Through rigorous empirical analysis of the inverted U-shaped correlation between IPP and innovative achievements, it advances the scholarly discourse by furnishing empirical evidence that critiques and enhances the ongoing debate over the optimal degree of IPP that promotes innovation without imposing stifling constraints. This contribution provides a nuanced perspective to the enduring discourse regarding the ideal level of IPP, one that nurtures innovation without impeding its progress.

1) Revealing the double-edged sword effect of intellectual property protection

The research of this paper finds that the impact of intellectual property protection on firms' innovation is not a single promotion or inhibition but presents an inverted U-shaped relationship. This means that at the initial stage of intellectual property protection, with the strengthening of protection, the innovation activities of firms will be promoted, because intellectual property protection provides firms with the guarantee of innovation results and stimulates the innovation drive of firms. However, when intellectual property protection reaches a certain level, excessive protection may hinder firms' innovative activities, as too strong protection may restrict the diffusion of technology and co-operation, resulting in firms falling into technology blockades and innovation rigidity. This finding reveals the double-edged sword effect of intellectual property protection and provides a new perspective for understanding the relationship between intellectual property protection and firm innovation.

2) Deepening the understanding of the relationship between intellectual property protection and firms' innovation

The traditional view tends to believe that there is a single linear relationship between intellectual property protection and firm innovation, the stronger the protection, the more active the firm's innovation activities. However, the research in this paper breaks this traditional view and reveals an inverted U-shaped relationship between the impact of intellectual property protection on firm innovation through empirical analyses. This finding deepens our understanding of the relationship between intellectual property protection and firms' innovation and makes us realise that intellectual property

protection is not a once-and-for-all solution but needs to be moderately adjusted and optimised according to the actual situation of firms and the market environment.

3) Enriched academic research in related fields

The research in this paper not only enriches the research field of the relationship between intellectual property protection and firms' innovation but also provides valuable references and lessons for the research in other related fields. For example, the double-edged sword effect and inverted U-shaped relationship of intellectual property protection can also be considered in research in the fields of technology transfer and co-operation and innovation in order to understand the impact of intellectual property protection on innovation activities more comprehensively.

The Moderating Influences of Technological Innovation and Research & Development (R&D) Capability:

This research endeavors to contribute to the development of a more intricate theoretical framework of innovation dynamics by scrutinizing the mediating effects of technological innovation and R&D capabilities. By doing so, it facilitates a deeper comprehension of the intricate interplay between distinct internal corporate competencies and external legal constructs, such as intellectual property protection (IPP), thereby enhancing our understanding of how these factors jointly shape the innovation landscape.

1) Enhancing the Theoretical Foundation of Innovation Dynamics

The examination of technological innovation and R&D capability as mediators not only refines but also expands the theoretical landscape of innovation dynamics. It posits that these two factors act as bridges, connecting internal organizational strengths with external environmental stimuli, thus providing a more nuanced view of the innovation process. This enriched theoretical model enables scholars and practitioners alike to better comprehend the multifaceted nature of innovation and its determinants.

2) Interplay Between Internal Capabilities and External Regulations

By exploring the interaction between firms' internal technological innovation and R&D capabilities, and external legal frameworks (particularly IPP), the research highlights the intricate balance that firms must strike. It reveals how robust R&D capabilities foster technological advancements, which in turn require adequate IPP

mechanisms to safeguard investments and incentivize further innovation. Conversely, a favorable IP environment can stimulate R&D investments and technological breakthroughs, creating a virtuous cycle of innovation.

3) Facilitating Strategic Decision-Making

The insights gained from this research inform strategic decision-making processes within firms. By recognizing the mediating role of technological innovation and R&D capability, managers can assess their organization's readiness to leverage external legal frameworks effectively. This enables them to allocate resources more efficiently, prioritize R&D projects, and develop strategies that maximize the potential benefits of IPP while minimizing risks associated with technology spillovers or infringement.

4) Implications for Policy Makers

The findings also carry implications for policymakers seeking to foster a conducive environment for innovation. By acknowledging the significance of both technological innovation and R&D capability as mediators, policymakers can design more targeted interventions aimed at strengthening these capabilities within firms. Furthermore, they can refine IP laws and regulations to better align with the needs of innovators, ensuring that the legal framework supports rather than hinders technological progress and economic growth.

5) Cross-Sectoral and Cross-Cultural Comparisons

The proposed theoretical model offers a framework for comparing innovation dynamics across different sectors and cultures. By examining how technological innovation and R&D capability mediate the relationship between internal firm capabilities and external legal frameworks in diverse contexts, researchers can identify commonalities and differences in innovation patterns. Such comparisons can inform the development of tailored strategies and policies that are responsive to the unique challenges and opportunities faced by firms operating in specific sectors or cultural environments.

Contextualizing IPP within the Dynamics of Emerging Markets: A Sichuan Province of China Case Study.

This research makes a substantial contribution to the theoretical corpus by situating IPP within the distinctive economic and regulatory milieu of Sichuan Province, an emerging market context. By doing so, it offers novel insights that may diverge from those derived from studies conducted in more mature economic systems, thereby enriching our understanding of the complex interplay between IPP and the specific socio-economic factors characterizing emerging markets.

1) Economic Development and IPP Strategy Alignment

The study highlights how IPP strategies need to be tailored to the stage of economic development in emerging markets. In Sichuan Province, for instance, the research may reveal that while stronger IPP is generally beneficial for fostering innovation and attracting foreign investment, its implementation must consider the region's current industrial structure, technological capabilities, and resource allocation priorities. This nuanced understanding offers practical guidance for policymakers in designing IP policies that align with the province's developmental trajectory.

2) Regulatory Heterogeneity and Enforcement Challenges

The unique regulatory environment in emerging markets, including Sichuan Province, poses distinct challenges to IP enforcement. The research contextualizes these challenges, exploring how variations in legal frameworks, judicial efficiency, and law enforcement capacity impact the effectiveness of IPP. It may identify areas where regulatory reforms or capacity-building initiatives are most urgently needed to create a more enabling environment for IP-intensive industries and innovative firms.

3) Cultural Norms and IP Awareness

The study also contributes to the understanding of how cultural norms and societal attitudes towards IP in emerging markets influence its protection and enforcement. In Sichuan Province, traditional values, economic practices, and consumer behavior may shape perceptions of IP rights and their importance. The research sheds light on these cultural dynamics, highlighting opportunities for public education and awareness campaigns to foster a stronger culture of IP respect and enforcement.

4) Innovation Ecosystems and IP Integration

By examining IPP within the broader context of Sichuan Province's innovation ecosystem, the research demonstrates how effective IP strategies can contribute to the development of robust innovation networks. It may explore how IPP promotes collaboration between universities, research institutions, and industry players, facilitating knowledge transfer and commercialization of research outcomes. Additionally, the study may identify gaps in the ecosystem where IP-related services and support mechanisms are lacking, informing policies aimed at strengthening these linkages.

5) International Integration and Comparative Perspectives

Finally, the research contextualizes IPP in Sichuan Province within the broader context of global economic integration and international IP norms. It compares and contrasts the province's IP environment with that of other emerging markets and developed economies, drawing insights from successful and unsuccessful cases. This comparative analysis provides valuable lessons for Sichuan Province as it navigates the path towards more effective IPP, while also contributing to the global discourse on IP policy and practice in diverse economic and regulatory settings.

5.3.2 Managerial Implications

Guiding Corporate Strategy in Sichuan Province:

This research endeavor aims to provide pragmatic strategic frameworks for enterprises within Sichuan Province, enabling them to enhance the efficacy of their innovation outcomes. By leveraging the insights garnered, companies can refine the alignment between their research and development (R&D) capability and technological innovation initiatives with the prevailing intellectual property protection (IPP) landscape, thereby maximizing their inherent innovation capabilities and potential.

1) IP-Driven R&D Roadmaps

Firms can develop IP-centric research and development (R&D) roadmaps that align their technological pursuits with the protection levels and opportunities afforded by the provincial IPP system. This involves identifying areas of innovation where robust IPP can maximize return on investment, whether through patents, trademarks, or other

forms of IP. By prioritizing research initiatives based on IP potential, firms can mitigate risks associated with intellectual property infringement and leverage IP as a strategic asset.

2) Collaborative Innovation Networks

Encouraging firms to foster collaborative relationships within and beyond Sichuan Province's innovation ecosystem is a pivotal strategy. The research will underscore the importance of partnering with universities, research institutions, and other industry players to pool resources, share knowledge, and co-create IP. Such collaborations can expedite the pace of innovation, expand technological reach, and facilitate the commercialization of breakthroughs. Moreover, joint IP ownership and licensing arrangements can strengthen the protection of collaborative outputs.

3) Adaptive Innovation Strategies

Given the dynamic nature of the IPP environment in emerging markets, firms in Sichuan Province must adopt agile and adaptive innovation strategies. The research will recommend regular assessments of the IPP landscape, market trends, and technological advancements to inform strategic pivots. This involves maintaining flexibility in R&D investments, diversifying innovation portfolios, and quickly capitalizing on emerging opportunities that align with their core competencies and IPP objectives.

4) IP Literacy and Talent Cultivation

Investing in employee training and education programs focused on IP literacy is crucial. The research emphasizes the need for firms to build a workforce that understands the value of IP, its legal framework, and strategies for protecting and leveraging it. By fostering a culture of IP awareness and incentivizing IP-related achievements, firms can attract and retain top talent, stimulate creativity, and foster a continuous innovation cycle.

5) Global IP Strategy Integration

As Sichuan Province's firms increasingly engage in international trade and investment, integrating a global IP strategy becomes imperative. The research will provide guidance on navigating international IP laws, treaties, and practices, as well as

strategies for managing cross-border IP disputes. Firms will be advised to secure international patent protection, trademark registration, and other forms of IP rights in key markets to safeguard their intellectual assets and expand their global footprint.

6) Government Engagement and Advocacy

The research underscores the value of firms engaging with provincial and national governments to influence IP policy and advocacy efforts. Firms can collaborate with government agencies, industry associations, and non-governmental organizations to advocate for stronger IPP measures, fairer IP dispute resolution mechanisms, and improved access to IP-related services and resources. Such engagement can contribute to a more favorable IPP environment that supports sustained innovation and growth.

Informing Policy Formulation:

The outcomes of this research hold significant value for policymakers tasked with crafting IPP frameworks that concurrently incentivize innovation and mitigate the risk of implementing overly restrictive measures that could potentially stifle creative endeavors. By informing such endeavors, the research endeavors to contribute to the development of more efficient and balanced IP legislation.

1) Balancing Incentives and Constraints

The study underscores the delicate balance that policymakers must strike between incentivizing innovation through robust IPP and ensuring these protections do not unduly restrict access to knowledge or impede further innovation. The results provide empirical evidence on the optimal level of protection needed to foster a vibrant and competitive innovation ecosystem.

2) Evidence-Based Policymaking

By grounding policy proposals in empirical data and analysis, policymakers can develop IPP frameworks that are grounded in reality and responsive to the dynamic needs of the innovative landscape. This approach minimizes the risk of implementing policies that are either overly restrictive or insufficient in addressing the challenges faced by innovators.

3) Tailored Approaches for Different Sectors

The research highlights the heterogeneity of industries and sectors in terms of their innovation needs and IP protection requirements. Policymakers can utilize the findings to design sector-specific IPP policies that cater to the unique characteristics and challenges of each industry, thereby enhancing their effectiveness and relevance.

4) Promoting Access to Knowledge

The study emphasizes the importance of maintaining a healthy balance between IP protections and the free flow of information and knowledge. Policymakers can incorporate mechanisms such as open innovation platforms, licensing frameworks, and compulsory licensing provisions to ensure that IP rights do not unduly impede the dissemination of knowledge and the building of upon existing innovations.

5) Addressing Emerging Challenges

As technology evolves and new business models emerge, so too do the challenges face by policymakers in crafting IPP frameworks. The research provides insights into these emerging trends and offers recommendations on how to adapt IP laws to address issues such as the digital divide, artificial intelligence, and the sharing economy.

6) Enhancing Transparency and Accountability

By incorporating the results of this research into the policymaking process, policymakers can enhance transparency and accountability in the development and implementation of IP laws. This includes conducting public consultations, publishing impact assessments, and regularly reviewing and updating IPP frameworks to ensure they remain fit-for-purpose and responsive to the evolving needs of innovators and society at large.

7) Fostering International Cooperation

In an increasingly globalized world, IPP frameworks must be harmonized to facilitate cross-border trade and investment. The findings of this research can inform international negotiations and cooperation efforts aimed at developing consistent and coherent IP laws that promote innovation globally while respecting national sovereignty and development priorities.

Augmenting Competitive Advantage:

Through the comprehension of the optimal degree of IPP, firms can strategically position themselves within the competitive arena, thereby nurturing an environment conducive to innovation and fostering a culture that underpins sustainable long-term success.

1) Optimizing Resource Allocation

By comprehending the optimal level of IPP, firms can strategically allocate resources towards R&D activities that are most likely to yield patentable innovations. This targeted investment enables firms to avoid wasteful spending on endeavors unlikely to generate competitive advantages, thereby maximizing the return on innovation investments.

2) Innovation Differentiation

Understanding the optimal IPP level facilitates firms in differentiating their products and services through unique innovations. Stronger IPP can serve as a barrier to entry for competitors, protecting firms' core technologies and designs from imitation. Conversely, in industries where collaboration and knowledge sharing are paramount, firms may adjust their IPP strategies to encourage open innovation and foster strategic alliances.

3) Risk Management and Mitigation

Firms that grasp the optimal IPP level are better equipped to manage and mitigate risks associated with intellectual property infringement. They can implement proactive measures, such as patent landscaping and risk assessment, to identify potential threats and devise strategies to protect their IP portfolio. Additionally, they can leverage their understanding of IPP frameworks to effectively navigate disputes and enforce their IP rights, preserving their competitive edge.

4) Market Signaling and Reputation Building

A well-defined IPP strategy can serve as a powerful market signal, communicating to investors, customers, and partners the firm's commitment to innovation and quality. This enhances the firm's reputation as an innovative player in its industry, attracting talent, investors, and partners who value a culture of innovation. Such

reputation can also lead to increased customer loyalty and premium pricing for innovative products.

5) Adaptability and Responsiveness

In a rapidly evolving business environment, firms that comprehend the optimal IPP level demonstrate greater adaptability and responsiveness to changes in market dynamics and technological advancements. They can swiftly adjust their IPP strategies to capitalize on emerging opportunities or address emerging threats, ensuring that their IP portfolio remains relevant and protective.

6) Collaborative Innovation Ecosystems

Recognizing the benefits of collaboration, firms can leverage their understanding of optimal IPP to foster collaborative innovation ecosystems. By striking a balance between protecting their core IP and encouraging knowledge sharing, firms can participate in joint research projects, open innovation platforms, and licensing agreements that accelerate the pace of technological advancement and create mutually beneficial outcomes.

7) Sustainable Competitive Advantage

Ultimately, by embracing an IPP strategy rooted in empirical understanding, firms can establish a sustainable competitive advantage. This advantage stems from a continuous stream of innovative products and services, effective risk management, and a reputation for innovation excellence. It positions firms at the forefront of their industries, enabling them to navigate change, capture market share, and drive long-term success.

Facilitating Sustainable Innovation:

This research endeavor seeks to elucidate strategies for fostering sustained innovation over extended periods, empowering enterprises to continually evolve and adapt to dynamic market conditions while preserving their competitive stance.

1) Cultivating a Culture of Continuous Learning

The research underscores the importance of fostering a corporate culture that embraces continuous learning and knowledge sharing. This includes establishing mechanisms for employees to stay abreast of industry trends, emerging technologies, and

best practices. By encouraging a growth mindset, firms can ensure that their innovation processes remain agile and responsive to evolving market demands.

2) Investing in Long-Term R&D Strategies

Sustainable innovation necessitates a commitment to long-term R&D strategies. The research will identify strategies for balancing short-term product enhancements with long-term technological breakthroughs. This may involve investing in fundamental research, building partnerships with academic institutions, and developing in-house capabilities for advanced research.

3) Adaptive Innovation Management Systems

Firms promoting sustainable innovation must develop and refine their innovation management systems to be adaptable and responsive. This includes implementing agile project management methodologies, fostering cross-functional collaboration, and establishing metrics and KPI to track innovation performance over time. The research will provide guidance on how to design and optimize these systems for long-term success.

4) Environmental and Social Responsibility in Innovation

Sustainable innovation goes beyond economic consideration; it also encompasses environmental and social responsibility. The research will explore how firms can integrate sustainability principles into their innovation processes, such as developing eco-friendly products, reducing waste in production, and addressing social needs through their innovations. This approach not only benefits society but also enhances firms' reputations and market positions.

5) Leveraging Data and Analytics for Informed Decision-Making

In the digital age, data and analytics play a crucial role in sustaining innovation. The research will emphasize the importance of collecting, analyzing, and utilizing data to inform innovation decisions. This includes using data to identify market trends, customer preferences, and technological opportunities, as well as monitoring the performance of innovation initiatives to inform continuous improvement.

6) Open Innovation and Collaboration Networks

Sustainable innovation often necessitates collaboration beyond organizational boundaries. The research will examine the benefits and challenges of open innovation models, including crowdsourcing, user-generated content, and strategic partnerships. It will also explore how firms can build and maintain effective collaboration networks with suppliers, customers, competitors, and other stakeholders to facilitate knowledge sharing and accelerate innovation.

7) Innovation Portfolio Management

To sustain innovation over time, firms need to manage their innovation portfolios strategically. This involves balancing investments across different innovation projects, stages, and technologies to ensure a steady flow of new products, services, and processes. The research will provide guidance on how to design and optimize innovation portfolio management strategies, taking into account factors such as risk, resource constraints, and market potential.

This research, therefore, not only contributes to academic knowledge but also offers practical solutions for enhancing innovation and economic development in Sichuan Province.

The researcher conducted in-depth interviews with managers of six state-controlled firms and private firms in Chengdu and Zigong, Sichuan Province, who all agreed with the researcher's viewpoints and made many suggestions.

With the intensification of globalised competition and the rapid development of technology, the impact of intellectual property protection on firms' innovation activities has become increasingly significant. In Sichuan Province, how firms' innovation can be promoted by effectively using intellectual property protection, especially how to optimise this relationship through the two mediating variables of technological innovation and R&D capability, is an urgent issue in current management practice. The purpose of this study is to explore this issue and provide concrete suggestions for firms' management practices.

1) Recognizing and balancing the double-edged effects of intellectual property protection

Recommendation: Firms should regularly assess the status and effectiveness of intellectual property protection to ensure that it is adequate to stimulate innovation but not so stringent as to impede technology diffusion and collaboration. A dedicated team or department can be set up to monitor and evaluate the impact of intellectual property protection policies.

Implementation: Enhance management's awareness of the double-edged sword effect of intellectual property protection through internal training or external counselling and formulate corresponding response strategies.

2) Strengthen the core position of technological innovation

Suggestion: Firms should clarify the core position of technological innovation in their development strategy and increase their investment in technological innovation. Encourage employees to participate in technological innovation activities by setting up an innovation fund and establishing an innovation incentive mechanism.

Implementation: Establish close cooperation with universities and research institutes to jointly carry out R&D projects and introduce advanced technology and management experience. At the same time, strengthen the construction of internal R&D team to enhance the overall R&D capability.

3) Enhancing R&D capabilities to meet the challenges of intellectual property protection

Suggestion: Firms should pay attention to the cultivation and introduction of R&D talents and establish a perfect R&D talent training system. At the same time, increase investment in R&D facilities, optimise R&D processes and improve R&D efficiency.

Implementation: Regularly organise R&D personnel to participate in industry exchange meetings and training activities to broaden their horizons and improve their skills. In addition, establish an R&D achievement evaluation and reward mechanism to stimulate the enthusiasm and creativity of R&D personnel.

4) Formulate differentiated intellectual property protection strategies

Suggestion: Firms should formulate their own intellectual property protection strategies according to the characteristics of their own industries, development stages and market environments. For example, for firms in the high-tech industry, they should pay more attention to the application and protection of patents; for firms in the traditional industry, they can protect their innovations by means of trademarks and copyrights.

Implementation: Establish a specialised intellectual property management department or team responsible for intellectual property application, protection and management. At the same time, strengthen cooperation with external intellectual property service organisations to obtain professional intellectual property consulting and agency services.

5) Strengthening Industry-University-Research Co-operation to Promote Technological Innovation

Suggestion: Firms should actively seek opportunities for cooperation with external innovation resources, such as universities and scientific research institutions, to jointly carry out R&D projects and technological innovation activities. Through industry-university-research co-operation, firms' innovation capability can be enhanced by obtaining more innovation resources and talent support.

Implementation: Establish an industry-university-research co-operation platform or mechanism to facilitate and support industry-university-research co-operation. At the same time, it strengthens the transformation and application of the results of industry-university-research co-operation and promotes the commercial application and market promotion of the innovation results.

This study provides specific recommendations for firms' innovation management practices through an in-depth discussion of the impact of intellectual property protection on firms' innovation in Sichuan Province and the mediating role of technological innovation and R&D capabilities therein. These suggestions help firms' innovation activities to be promoted by better utilising intellectual property protection to enhance their core competitiveness. In future management, firms should actively adopt

these recommendations and continuously optimise and improve their innovation strategies and intellectual property management systems.

5.4 Research Limitations and Recommendations for Further Research

5.4.1 Research Limitation

Despite the significance of investigating the impact of intellectual property protection mechanisms on corporate innovation within the context of Sichuan Province, the current research endeavor encounters certain constraints. Firstly, constraints pertaining to the accessibility and adequacy of data may undermine the precision and comprehensiveness of the analytical outcomes. Notably, some enterprises may exhibit reluctance in divulging sensitive information pertaining to their intellectual property safeguards, while others may be susceptible to varying degrees of reporting biases in their practices. Consequently, these factors may contribute to limitations in the study's conclusions, potentially hindering a comprehensive portrayal of the universal influence of intellectual property protection across all firms under consideration.

Secondly, the study may have inadequately accounted for the intricate interplay and combined influence of multiple factors beyond intellectual property protection on corporate innovation. Specifically, macroeconomic fluctuations, variations in market demand, and advancements in technological sophistication are also pivotal factors that can exert considerable impact on innovation endeavors within firms. The omission of these confounding variables may result in overly simplistic conclusions, thereby impeding an accurate appraisal of the distinct and isolated effect of intellectual property protection on corporate innovation.

Furthermore, the research might have inadequately addressed the intricate interplay of internal firm-specific factors that significantly influence innovation processes. These internal factors, encompassing corporate culture, the caliber of management, and the prowess of the R&D team, play a pivotal role in shaping the innovation landscape within firms. The omission of a comprehensive analysis of these internal dynamics may have contributed to a limited comprehension of the intricate

relationship between intellectual property protection and corporate innovation capabilities.

A notable limitation that warrants consideration is the failure of extant studies to incorporate temporal dynamics in the analysis of intellectual property protection policies. Given that the enactment and subsequent amendments to these policies are inherently time-variant, research endeavors may have inadequately scrutinized these temporal shifts. The disregard for temporal policy variances can potentially introduce inconsistencies within study findings, thereby impeding an accurate portrayal of the evolving impact of intellectual property protection on corporate innovation endeavors.

Ultimately, the confinement of research to a sole focus on the firm-level effects limits its capacity to holistically capture the intricacies of the broader innovation ecosystem. The intricate interplay among various stakeholders, including governmental bodies, research institutions, as well as firms situated upstream and downstream within the industrial value chain, necessitates a more comprehensive analytical framework. Consequently, restricting analyses to the firm-level domain may hinder a thorough comprehension of the multifaceted influence of intellectual property protection on the entirety of the innovation ecosystem.

In conclusion, while examining the implications of intellectual property protection on corporate innovation within the context of Sichuan Province constitutes a valuable pursuit, it is acknowledged that there exist numerous constraints pertaining to data accessibility, unaccounted-for synergistic effects, internal firm-specific factors, the dynamic nature of policy alterations over time, and the intricate intricacies of the broader innovation ecosystem. Consequently, future research endeavors must embrace a more exhaustive and nuanced methodological approach that comprehensively addresses these limitations, thereby fostering a deeper and more nuanced comprehension of the multifaceted effects of intellectual property protection on corporate innovation.

5.4.2 Recommendations for Further Research

This research offers significant benefits that justify funding, particularly in the context of Sichuan Province's economic and industrial landscape:

1) Enhancing Innovation Capacity: By examining the relationship between IPP and firm innovation outputs, the research will provide actionable insights for policymakers and business leaders in Sichuan Province. This will enable them to create a balanced IPP environment that maximizes innovation potential without stifling creativity.

Expanding upon the Enhancement of Innovation Capacity necessitates a profound comprehension of the intricate interplay existing between IPP and the multifaceted innovation ecosystems inherent within Sichuan Province. The research endeavor will meticulously explore the intricate mechanisms by which IPP exerts its influence, not merely on the quantitative aspects of firm innovation outputs, but also on their qualitative dimensions.

This exploration will encompass an analysis of how robust IPP frameworks incentivize firms, particularly within specific niches such as Zigong's gastronomic sector, to allocate resources towards R&D. By securing their intellectual assets, these frameworks foster an environment conducive to risk-taking and experimentation, thereby encouraging firms to embark on innovative endeavors.

To gain a nuanced perspective, the research will incorporate in-depth interviews with gastronomic firms in Zigong. These interviews will aim to uncover how IPP policies and practices impact their decision-making processes related to R&D investments, product innovation, and the protection of culinary traditions and innovations. Furthermore, the study will assess the extent to which these firms perceive IPP as a catalyst for growth and competitiveness within the gastronomic industry of Sichuan Province.

Moreover, the study will assess the potential trade-offs between stringent IPP measures and the free flow of knowledge, which is crucial for fostering incremental and radical innovations alike. By analyzing case studies of successful and less successful implementations of IPP policies in Sichuan, the research aims to identify best practices that balance the need for protection against the imperative for knowledge diffusion and collaboration.

The investigation will also explore the role of regional characteristics, such as the industrial structure, technological readiness, and the availability of skilled labor, in

shaping the effectiveness of IPP policies. This will enable policymakers to tailor their strategies to the unique context of Sichuan Province, ensuring that they are both responsive and effective in enhancing innovation capacity.

Additionally, the research will consider the impact of IPP on small and medium-sized enterprises (SMEs), which often face unique challenges in accessing and leveraging intellectual property rights. By examining the barriers and opportunities for SMEs within the IPP landscape, the study will offer recommendations for policies and programs that can level the playing field and empower these enterprises to contribute more meaningfully to the region's innovation ecosystem.

Ultimately, the research seeks to contribute to the development of a comprehensive and dynamic IPP framework for Sichuan Province that not only safeguards intellectual property but also fosters a vibrant and sustainable innovation ecosystem. By providing actionable insights grounded in rigorous empirical analysis, the study aims to empower policymakers and business leaders to make informed decisions that maximize the region's innovation potential while nurturing a culture of creativity and continuous improvement.

2) Enhancing Regional Economic Growth: The research findings, which elucidate the intricate interdependencies between intellectual property protection mechanisms, technological advancements, and the R&D competencies of local enterprises, constitute a foundational basis for the development of targeted policy interventions aimed at reinforcing the economic landscape of Sichuan Province. By nurturing a robust innovation ecosystem that incentivizes investments in pioneering technological advancements and research pursuits, these policies have the capacity to instigate a virtuous cycle of economic growth and prosperity.

Specifically, the identification of effective IPP strategies tailored to the regional context can stimulate firms to engage in more ambitious R&D projects, confident in the protection of their intellectual assets. This, in turn, fosters technological breakthroughs that can be commercialized, leading to the emergence of new products, services, and industries. The resulting innovation-driven economic activity will not only

enhance the competitiveness of local firms on a national and international scale but also contribute significantly to the diversification and resilience of the regional economy.

Moreover, the proliferation of high-tech industries and the expansion of R&D activities often lead to the creation of high-skilled jobs, which can attract talent from within and outside the province. This influx of skilled labor further enriches the innovation ecosystem, fostering a positive feedback loop between economic growth, job creation, and the development of human capital.

Additionally, the research findings may also inform the design of supportive infrastructure and services, such as specialized incubators, funding mechanisms, and training programs, that can accelerate the growth trajectory of startups and SMEs in the region. By nurturing these early-stage enterprises and helping them navigate the complexities of intellectual property management, these initiatives can contribute to the emergence of new growth engines that drive sustainable economic development in Sichuan Province.

In summary, the implications of this research extend far beyond the realm of IPP policy design, as they have the potential to transform the regional economic landscape by fostering a culture of innovation, promoting technological advancements, and enhancing the competitiveness of local firms. By leveraging the insights gained from this study, policymakers and business leaders in Sichuan Province can work together to create a vibrant and resilient economy that thrives on the power of intellectual property and innovation.

3) Enhancing National Intellectual Property Policy Frameworks: The research outcomes transcend the geographical confines of Sichuan Province, constituting a substantial repository of empirical insights that can serve as a valuable resource for informing and refining national-scale IPP policy formulations. This study, by elucidating the intricate dynamics between IPP, technological advancements, and regional economic proliferation, advocates a well-balanced strategy that not only safeguards intellectual property rights but also nurtures a thriving innovation ecosystem, thereby presenting a compelling rationale for policy reform.

As a model for other regions within China, the research underscores the importance of contextualizing IPP policies to the unique characteristics and needs of each region. It highlights the significance of tailoring strategies that not only protect against intellectual property infringement but also encourage collaboration, knowledge sharing, and the free flow of ideas – all essential components of a thriving innovation landscape.

By showcasing the potential benefits and challenges associated with different IPP frameworks, this study contributes to a more informed discourse on national policy development. Policymakers can draw upon these insights to refine existing policies or design new ones that are more responsive to the dynamic needs of the innovation economy.

Furthermore, the research emphasizes the role of regional collaboration and benchmarking in enhancing national IPP policies. By comparing and contrasting the experiences of Sichuan with other regions, policymakers can identify best practices and adapt them to their own contexts, thereby promoting a more harmonious and effective national IPP system.

Ultimately, the implications of this research extend to the global arena, as China's experience in balancing IPP and innovation offers valuable lessons for other countries striving to navigate similar challenges. By contributing to the global discourse on IPP policy formulation, this study fosters international cooperation and knowledge exchange, thereby advancing the shared goal of fostering a world where intellectual property is protected, innovation thrives, and economic prosperity is sustained.

4) Enhancing Sichuan Province's Attractiveness for Foreign Direct Investment (FDI) in High-Technology Sectors: This research underscores the pivotal significance of elucidating the intricate mechanisms through which IPP nurtures innovation, thereby bolstering Sichuan Province's competitiveness as a preferred destination for FDI in high-tech industries. As multinational enterprises and global investors increasingly factor in robust IPP systems as a key criterion in their investment strategies, the present study's findings offer a compelling rationale for Sichuan's steadfast commitment to safeguarding intellectual assets and cultivating an environment that

fosters technological progress and innovation, thereby presenting a robust case for attracting FDI in the high-tech domain.

Moreover, the research underscores the economic spillover effects of such investments. By attracting FDI into high-tech sectors, Sichuan Province can expect not only an influx of capital but also the transfer of advanced technologies, know-how, and best practices from foreign enterprises. This, in turn, stimulates local industries to upgrade their technological capabilities, enhances their competitiveness, and fosters the emergence of new industries and value chains.

Additionally, the establishment of strong IPP frameworks signals to foreign investors the province's commitment to a fair and predictable business environment, thereby enhancing its credibility and reputation as an attractive investment hub. This, coupled with Sichuan's strategic location, abundant natural resources, and skilled labor force, creates a compelling narrative for potential investors seeking to expand their global footprint in the high-tech sector.

Furthermore, the research highlights the importance of ongoing dialogue and collaboration between government agencies, local industries, and international partners to refine and adapt IP policies to the evolving needs of the innovation economy. Such engagements facilitate the creation of tailored incentives and support mechanisms that can further sweeten the deal for foreign investors, fostering long-term partnerships and sustainable economic growth.

In conclusion, by elucidating the pivotal role of IPP in driving innovation and economic development, this research presents a compelling argument for Sichuan Province to leverage its strengths and capitalize on the opportunities presented by attracting foreign investments in high-tech industries. Through a concerted effort to enhance IPP, Sichuan can position itself as a premier destination for international investors seeking to capitalize on the vast potential of China's burgeoning innovation landscape.

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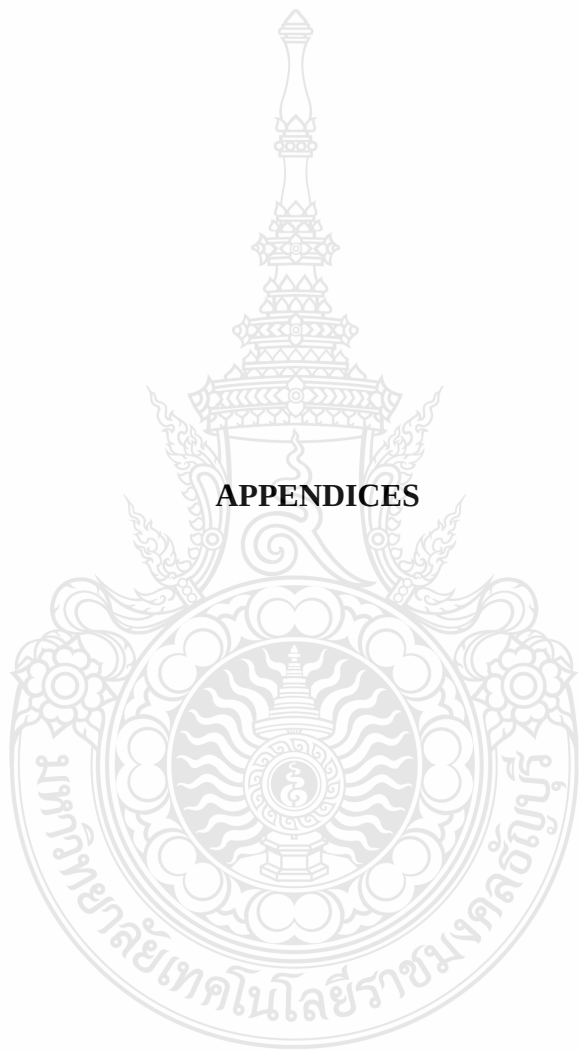
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APPENDICES



APPENDIX A
Questionnaire

Notice

A survey on "Effect of Intellectual Property Protection on Firm Innovation in Sichuan Province" is now being conducted. The main goal of this survey is to comprehend the impact of intellectual property rights protection on state-controlled firms and private firms in Sichuan Province in order to fully comprehend the current situation of the creation and protection of intellectual property rights by innovative entities.

The following topics will be the main focus of the study:

1. The actual situation and variations in intellectual property rights protection between state-controlled and private firms;
2. The innovation investment and innovation efficiency of various types of firms when faced with intellectual property rights protection;
3. The strength of intellectual property rights protection for businesses in the area;
4. Policy recommendations for businesses' innovation activities.

This questionnaire has been made available by the study team, and we would appreciate it if you took the time to fill it out. There are 23 questions in total and answering them will take you roughly 10 minutes. We appreciate your support of our efforts. We wish you well in all of your endeavors!

Please rate how much you agree or disagree with the following statements:

Please indicate your preference ☒

1. The kind of registration for the firm is: (please tick only one)
☐ State-controlled firm. ☐ Private firm.
2. Your area: (please tick only one)
☐ Chengdu. ☐ Zigong.
3. What level of education do managers in your firm have, on average? (please tick only one)
☐ Bachelor's degree ☐ Master's Degree ☐ Doctoral Degree
4. How many years has your firm been in business? (please tick only one)
☐ Less than 5 years ☐ 5-10 years
☐ 10-15 years ☐ 15 years and over

5. The total number of employees in your firm is:

Please rate your level of agreement with the following:

Strongly Disagree = 1, Disagree = 2, Neutral = 3, Agree = 4, and Strongly Agree = 5.

Statement	Level of agreement				
	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
1.Legislative level.					
1.Firms understand and are aware of the high level of intellectual property protection.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
2.Firms understand the history of intellectual property legislation.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
3.Firm knows how to get a registration for trademarks, copyrights and patents.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
2. Level of law enforcement.					
4.Firms see intellectual property protection as important factor for internal innovation.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
5.Firms understand intellectual protection.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
6.Firms know the type of intellectual property.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
3.Level of economic development.					
7.The level of economic development in the location of the firm is good.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
8.Intellectual property protection encourages firms to innovate more.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
9.Intellectual property protection is conducive to promoting technological progress and R&D.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
4.Technological innovation.					
10.High level of technological innovation within your the firm.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
11.The firm has established a top-notch research and development staff.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
12.The firm has a sound strategy for embracing technological innovation.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
13.Your firm that believes technological innovation is important to its success.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
14.Technology advancement significantly affects firm.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Statement	Level of agreement				
	1□	2□	3□	4□	5□
5. R&D capability.					
15.R&D significantly influences firm innovation.	1□	2□	3□	4□	5□
16.The firm is a leader in R&D compared to other firms in same industry.	1□	2□	3□	4□	5□
17.The firm has established a top-notch R&D staff.	1□	2□	3□	4□	5□
18.R&D has had a beneficial effect on the firm.	1□	2□	3□	4□	5□
6. Firm innovation outputs.					
19.Income from new product sales meets expectations.	1□	2□	3□	4□	5□
20.Good feedback from the market for new products.	1□	2□	3□	4□	5□
21.New products are accurately targeted at the target customer.	1□	2□	3□	4□	5□
22.New products are in line with market trends within the industry.	1□	2□	3□	4□	5□
23.Your firm's new product has received positive feedback from customers.	1□	2□	3□	4□	5□



APPENDIX B
Synopsis of the Interview

I. Introduction

Opening Introduction:

Thank the interviewee for accepting the interview.

Briefly introduce the purpose of the interview and the background of the dissertation research.

II. Basic Information of Interviewees

Background Understanding:

Please briefly introduce your professional background and experience in the field of intellectual property protection or business innovation.

What role does your company or organization play in business innovation activities in Sichuan Province?

III. Status of Intellectual Property Protection

1. What is your opinion of the current policy on intellectual property protection? Do you think it is perfect enough?

2. How is the implementation of intellectual property protection in your firm? What are the specific protection measures?

IV. Impact of Intellectual Property Protection on Business Innovation

3. How do you think intellectual property protection affects firms' willingness to innovate? Can you give examples?

4. Does intellectual property protection help to improve firms' innovation capability and innovation efficiency? Please tell us about your experience.

5. How does your firm combine intellectual property protection strategies with technological innovation? How has this combination positively impacted the firm's innovation?

6. Can you share some cases of changes in your firm's technological innovation triggered by the adjustment of your intellectual property protection strategy?

7. Has intellectual property protection affected your firm's R&D capability? If yes, how?

8. How do you see the positive or negative relationship between intellectual property protection and R&D capability? What are the actual data or cases to support your view?

V. Concrete Practices of Intellectual Property Protection and Business Innovation

9. What innovations in your firm have benefited from intellectual property protection? Please describe them in detail.

10. Has intellectual property protection contributed to the commercialization of innovations in your firm? Can you give some examples?

11. In the process of commercializing your innovations, what problems have you encountered in relation to intellectual property protection? How were they resolved?

12. Does intellectual property protection help firms gain competitive advantage in the market? Can you share some practical cases?

VI. Outlook on Future Intellectual Property Protection

13. What are your expectations for the future of intellectual property protection policy? In what aspects do you hope the policy will be improved?

14. With the development of science and technology and the advancement of globalization, what new challenges and opportunities will intellectual property protection face?

15. How do you think firms should respond to these challenges and opportunities in order to better promote innovation?

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